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DIAGNOSIS OF TUMORS OF THE BREAST BY SIMPLE ROENTGENOGRAPHY*

CALCIFICATIONS IN CARCINOMAS

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THE roentgen study of the breast should now be included in the clinical investigation of symptoms in the diagnosis of mammary pathology. In 1935, for the first time in Montevideo, Professors Carlos M. Domínguez and Eduardo Blanco Acevedo called attention to the value of roentgenography in studies of carcinoma of the breast. They had arrived at some very interesting results.

With the improvement of roentgenologic and interpretative techniques in this field we have introduced, we are now usually able to individualize the different images necessary for a precise diagnosis of the mammary parenchyma.

Due to the complex pathology of the breast and to the small difference of opacity between normal and pathologic tissues, the roentgen study demands a perfect technique.

ROENTGENOGRAPHIC TECHNIQUE

Craniocaudal projection is employed. First, a topographic roentgenogram is made, using a cone large enough to cover the total area of the breast. Then, a second film is exposed, localizing the exact site of the tumor and using a cone of the smallest possible diameter, so as to reduce secondary radiation (Fig. 1).

Technique: Focus-film distance 60 cm., 30 kv. (peak), 5 ma. sec., for each centimeter of thickness of the breast. Non-screen films are employed. Recently, and especially in the fibrous breast, where conditions for roentgenologic contrast are lacking, when looking for calcifications we have successfully reduced the potential to about 20 kv. (peak), employing 30 cm. focus-film distance and an exposure varying according to the thickness of the breast.

We also find it convenient to exert a slight pressure with the cone on a small cotton pad placed between the cone and the breast so that the least quantity of breast tissue is interposed.

Tumors localized near the upper portion of the breast are not seen clearly in the craniocaudal projection; consequently, the technique must be complemented by a lateral film study.

* I wish to thank Professors Carlos M. Domínguez and Larghero Ibarz, and Doctors Mautone, Pradines, Castro, Cassinelli, Scolnik, and Scandroglio for their anatomic and pathologic collaboration; and Professor James T. Case of Northwestern University Medical School, Chicago, for aid in the English translation.

FIG. 1. Position of the patient for obtaining a craniocaudal film. Observe the characteristics of the cone and the compression pad interposed between it and the breast. The film, enclosed in a black paper envelope, is in contact with the breast.

ROENTGENOGRAPHIC INTERPRETATION

We shall present the most frequent and characteristic roentgen findings of positive diagnostic value which we have found.

Benign Tumors. Encapsulated benign tumors, fibroadenomas or cysts produce rounded or multilobulated images with smooth borders, sometimes seen partially or totally surrounded by a transparent halo which separates it from the mammary tissue in immediate relation to the tumor. The size of the tumor on the roentgenogram corresponds very closely to its palpable size. Roentgenographic study of encapsulated tumors must be supplemented by transillumination. Cysts filled with citrine liquid are transparent, fibroadenomas present a medium opacity and cystadenocarcinomas, because of their usual hemorrhagic contents, are notably opaque.

Malignant Tumors. The roentgen shadows of adenocarcinoma of the breast most frequently encountered have the following characteristics:

Size: The diameter may be from 1.0 to 4.0 cm., but the basic element for diagnosis is that the size seen on the roentgenogram is generally smaller than the palpable size.

Borders: These do not usually present the same sharpness of outline as seen with benign tumors; on the contrary, they have ragged borders with numerous spicules of variable lengths, which radiate from the periphery into the surrounding mammary tissue. This spiculated border is character-

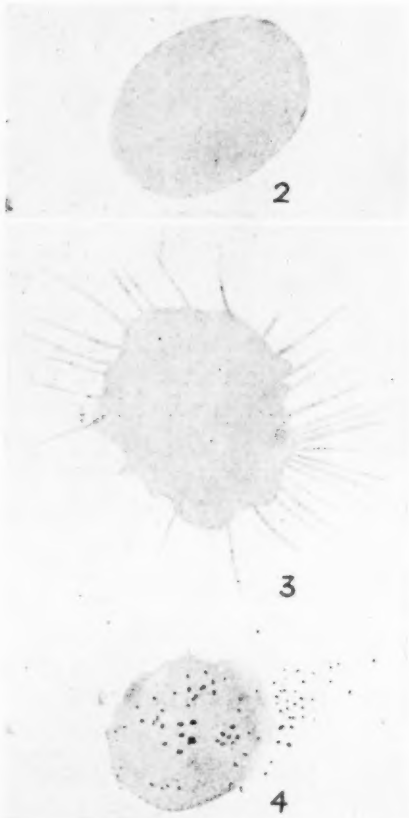

FIG. 2, 3, and 4. Drawings of the principal roentgenographic aspects of mammary tumors. FIG. 2. Encapsulated tumor with clearly defined contours. FIG. 3. Spiculated contours of a scirrhous carcinoma. FIG. 4. Clustering of innumerable calcifications, like fine grains of salt, in the tumor nodule and its surroundings, characteristic of a malignant lesion.

istic of malignant tumors and discloses its eminently scirrhous nature.

Occasionally the shadows of malignant tumors present smooth borders quite similar to those seen in encapsulated tumors and a differential diagnosis may then be dif-

Fig. 5. Encapsulated nodule, with clear sharp contours. Fibroadenoma.

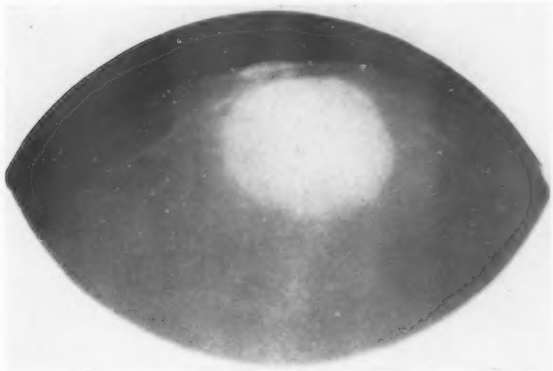

Fig. 6. Rounded, encapsulated shadow. Simple cyst.

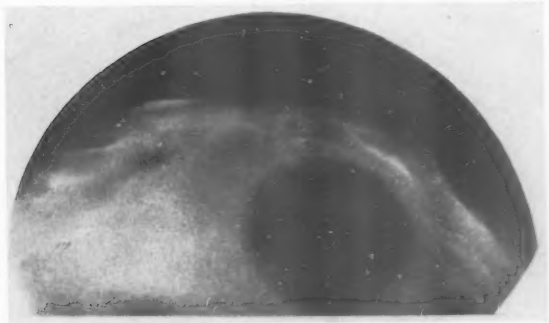

Fig. 7. Encapsulated tumor, transparent to the roentgen rays, characteristic of galactoceles with butter-like content.

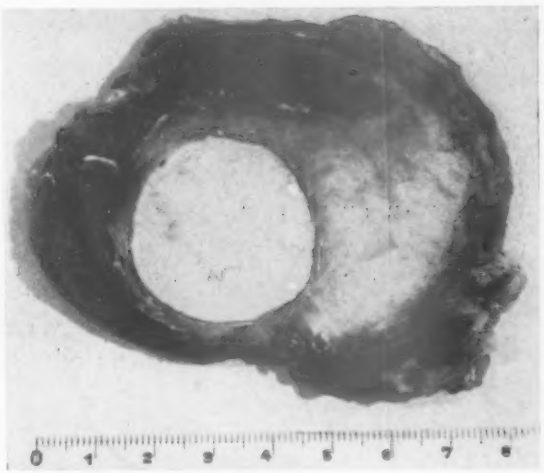

Fig. 8. Partial mammectomy performed on the patient referred to in Figure 7. (Dr. A. Valdez Olascoaga. Anatomo-pathologic study: Professor Carlos M. Domínguez.)

Fig. 9. Rounded shadow, opaque to the roentgen rays, with an encapsulated appearance. Tuberculous abscess.

Fig. 10. Nodule with spicules which radiate to the skin, retracting it. Scirrhous epithelioma. (Halsted operation: Dr. Jaumandreu.)

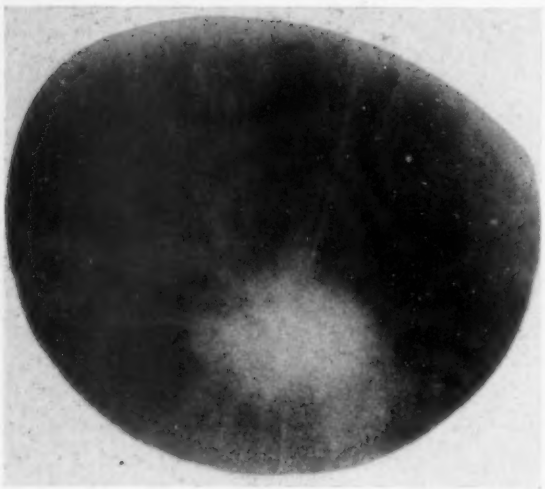

FIG. 11. Tumor with spiculated contours. Epithelioma. (Halsted operation: Dr. L. D. Bottaro.)

ficult; but these difficulties are gradually overcome with experience.

5. Density: The shadow of the tumor is uniformly dense, sometimes containing a scattering of multiple, punctate calcifications.

CALCIFICATIONS IN MALIGNANT TUMORS

These calcifications, which constitute a roentgenographic sign to which we attribute a singular diagnostic value, are characterized by the presence of innumerable punctate calcifications resembling fine grains of salt, generally clustered in a region of the breast. These calcifications, which at first might pass as defects in the film, may be found as follows:

1. Inside the tumor nodule.
2. Inside and surrounding the nodule.
3. As the only roentgen sign; that is, without nodular image.

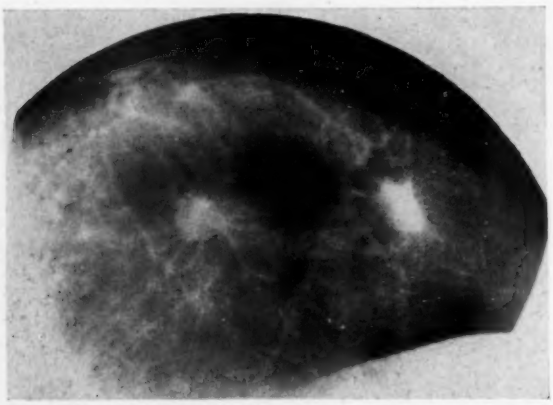

FIG. 12. Two nodules are observed with spiculated contours which, radiating to the neighboring mammary tissue, form a bridge between them. They correspond to two small scirrhous carcinomas, simultaneous in the same gland, one of them not being palpable. (Halsted operation: Professor A. Stábile. Anatomo-pathologist: Dr. Mautone.)

FIG. 13. Nodule with ragged contours. Epithelioma.

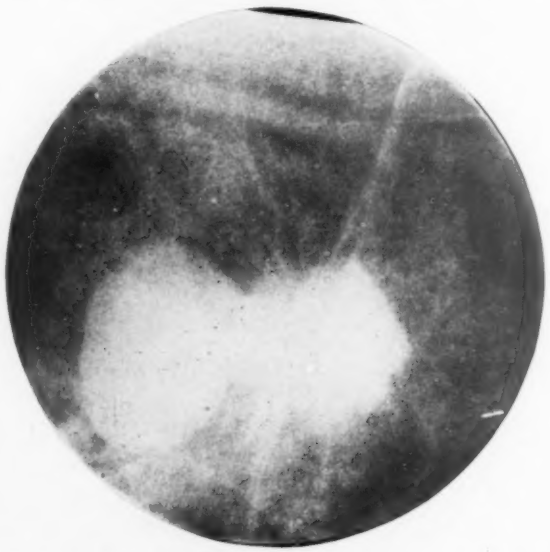

FIG. 14. Two nodules are observed: one of them with spiculated contours, the other encapsulated.

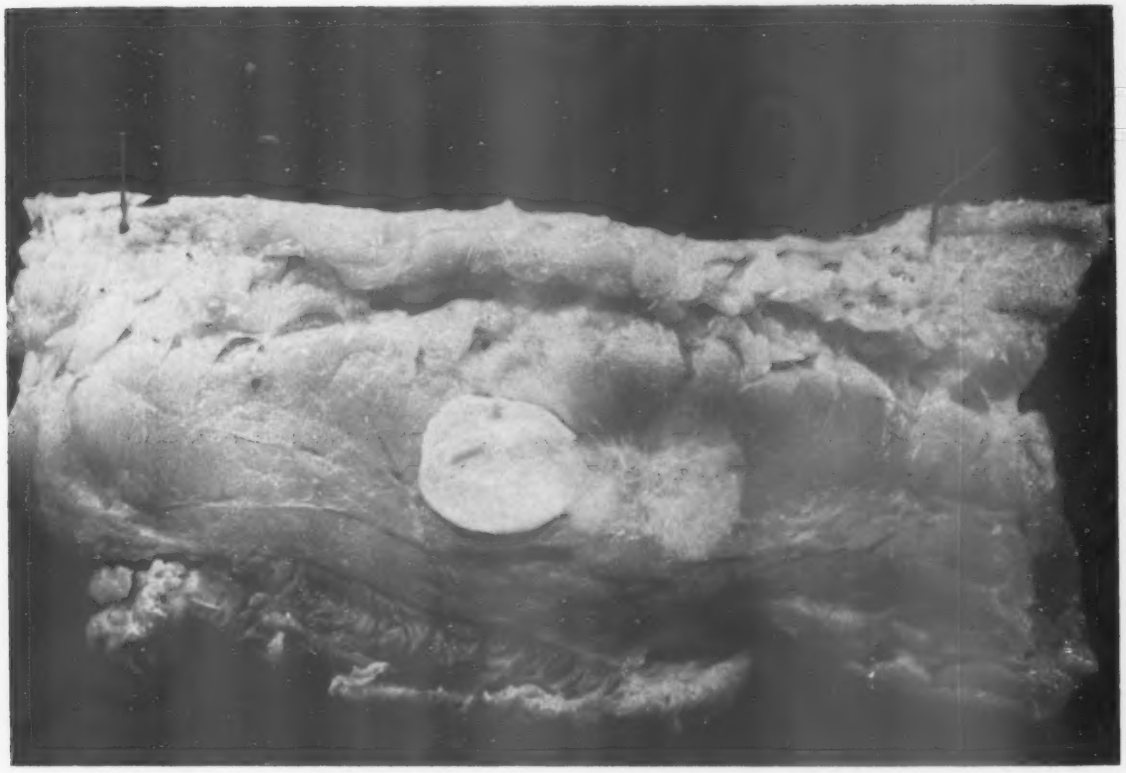

Fig. 15. Halsted operative specimen of the preceding case (Fig. 13 and 14): Professor J. J. Crottogini. Photograph of a cross section of the operative specimen. The spiculated nodule corresponds to a scirrhous epithelioma, and the encapsulated nodule to a benign tumor. Professor C. M. Domínguez.

These calcifications seen inside the tumor nodule frequently correspond to a scirrhous epithelioma the diagnosis of which depends upon the roentgenologic characteristics of the nodule. When calcifications surpass the borders of the tumor nodule or when they are seen without a tumor nodule, they generally correspond to canalicular forms, and especially to comedocarcinoma. This is the anatomic form in which calcifications are most frequently seen, even without the existence of a palpable tumor.

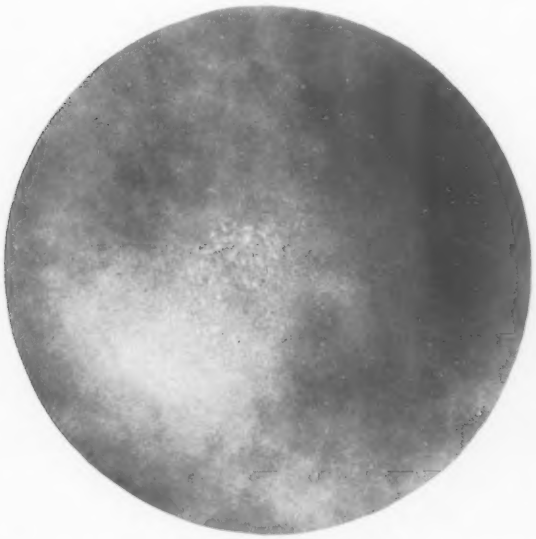

Fig. 16. Cluster of small calcifications, like fine grains of sand, in the tumor nodule.

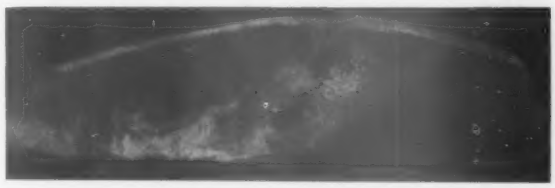

Fig. 17. Halsted operative specimen of the preceding case (Fig. 16); Dr. E. Schaffner. Roentgenogram of the anatomic section of the operative specimen, where the calcifications can be seen more clearly. Histopathologic study: Ductal epithelioma of the comedo type. Professor C. M. Domínguez.

FIG. 18. Scattering of innumerable punctate calcifications grouped in and around the tumor nodule.

As the clinical and histopathologic diagnosis of this form of mammary cancer may present serious difficulties, we stress the

FIG. 19. Roentgenogram of a cross section of the operative specimen of the preceding case (Fig. 18). Halsted operation: Dr. E. Schaffner. The small calcifications, like fine grains of salt, are clearly seen.

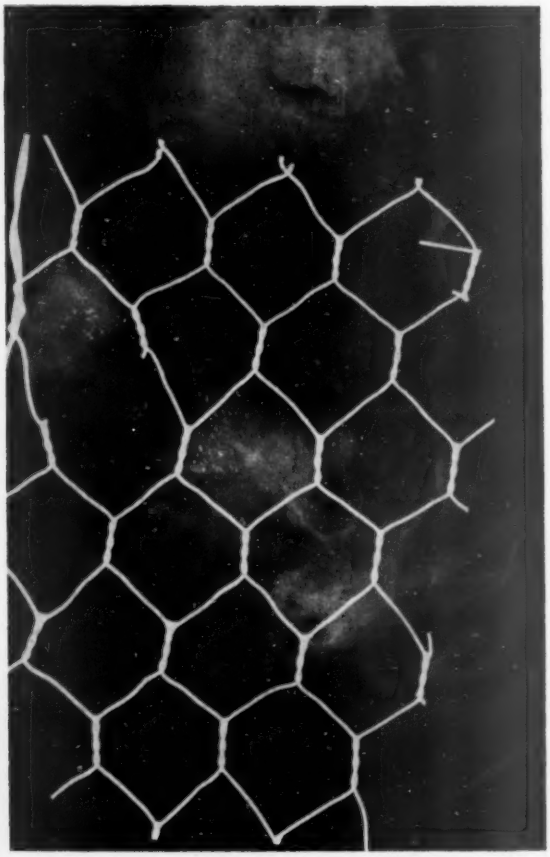

FIG. 20. Technique employed for localizing the calcifications in the operative specimen. All zones showing calcifications were studied. Their histopathologic examination revealed the existence of a solid epithelioma with large alveoli, with small cells, and central caseous necrosis with calcareous infiltration. (Professor P. Larghero Ibarz and Dr. Pradines.)

importance of these calcifications, which may be seen in extensive as well as in incipient lesions.

The roentgenographic study of the opera-

FIG. 21. Scattering of dotlike calcifications in all the breast.

tive specimen also permits the localization of the tiny calcifications for histopathologic study, and thus aids in finding a small cancer which would otherwise be overlooked.

We firmly believe that the recognition

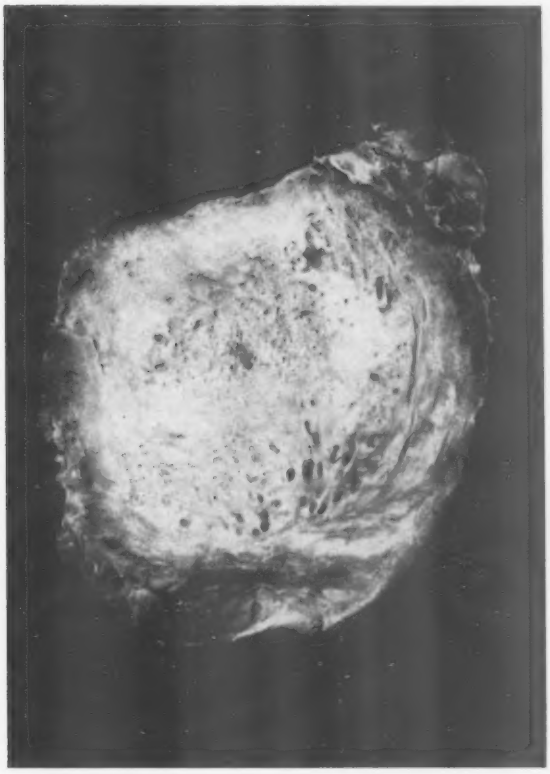

Fig. 22. Halsted operation on the same case by Professor J. C. del Campo. Photograph of a cross section of the operative specimen.

and demonstration of this roentgenographic sign constitutes one of the easily observed aspects in which mammary cancer is presented, especially in its ductal forms which seem to have slow growth during the first stage of evolution, and therefore susceptible of detection in prophylactic examinations of women who do not yet present clinical tumor symptomatology. With a systematic prophylactic roentgenographic examination of all women with antecedents of cancer in their family, we enter a new stage in the fight against mammary cancer.

Not all mammary calcifications are associated with malignant processes; they may

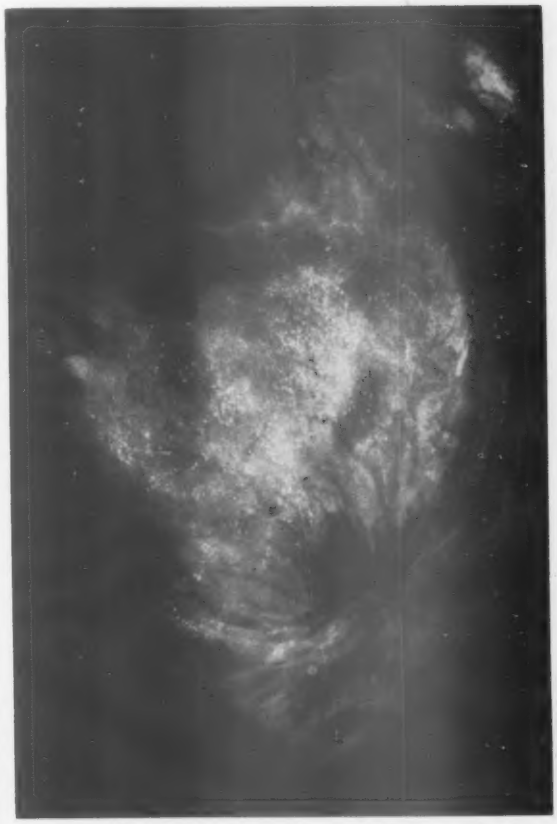

Fig. 23. Roentgenogram of the operative specimen of the same case (Fig. 21), showing the dotlike calcifications.

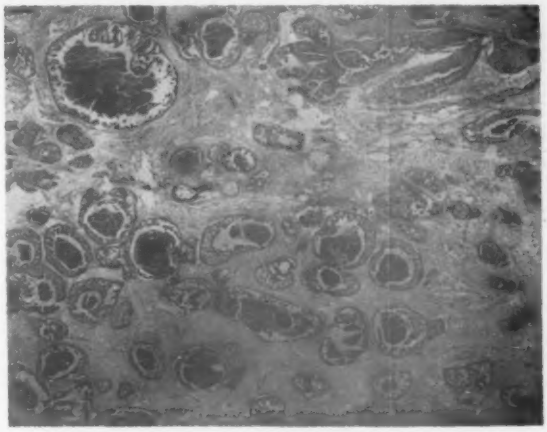

Fig. 24. Photomicrograph of the same case (Fig. 21) (Dr. J. F. Cassinelli.) Ductal epithelioma with central necrosis, and calcifications (comedocarcinoma). No glandular metastasis.

be found, much less frequently, in benign processes, whether in tumors, in blood vessels or as incrustations in the milk ducts.

FIG. 25. Scattering of dotlike calcifications.

FIG. 26. Roentgenogram of the operative specimen of the preceding case (Fig. 25), where the calcifications are seen more clearly. Histopathologic study performed by Dr. J. J. Scandroglio revealed a comedocarcinoma.

FIG. 27. Extensive dissemination of calcifications.

With sufficient experience, differential diagnosis between calcifications of malignant processes which we have described and calcifications in benign processes is generally easy. In the latter, especially in fibroadenomas, they differ from malignant calcifications in that they are larger, and therefore more easily visible, fewer in number, and are sometimes disposed around the

FIG. 28. Roentgenogram of the operative specimen (Fig. 27) of the preceding case, which shows mammary calcifications as well as those of an axillary gland. The histopathologic study performed by Professor Larghero Ibarz and Dr. Pradines showed scirrhous epithelioma with small cells, contained in large and small alveoli at the level of the mamma.

Caseous necrosis: The large alveoli have a comedocarcinoma appearance; but there is a predominance of cordlike infiltrations and small alveoli. Calcic infiltration.

Ganglia: Infiltration of the adenocarcinoma; complete obliteration of the structures of the lymphatic tissues. Fibroplastic reaction of the stroma. The afferent lymphatic cells are filled by carcinomatous cells.

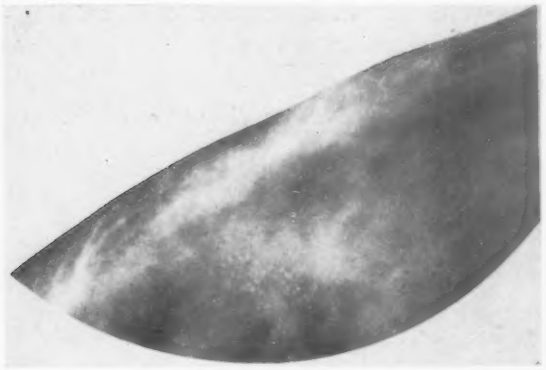

Fig. 29. Multiple dotlike calcifications inside a tumor nodule: scirrhous epithelioma.

Fig. 30. Dissemination of the calcifications like grains of sand, scattered through the breast in a papillary epithelioma.

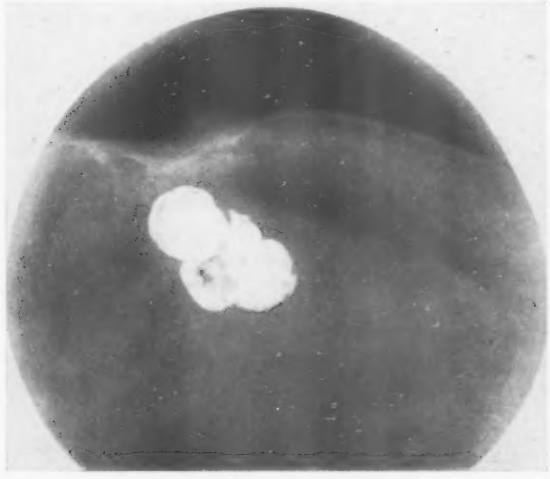

Fig. 31. Gross calcification in a fibroadenoma. Resection of the nodule. (Dr. R. Belloso.)

periphery of the tumor capsule. Calcifications in the lactiferous ducts may also

Fig. 32. Multiple calcifications disposed in the periphery of a fibroadenoma.

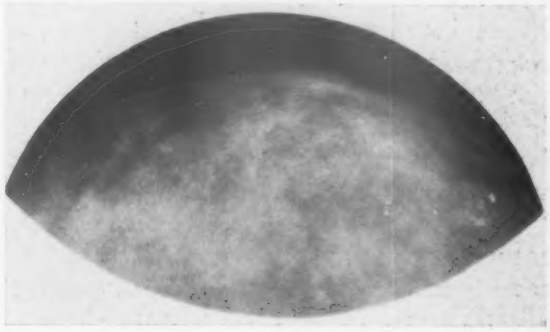

Fig. 33. Three easily seen calcifitions. Small fibroadenoma.

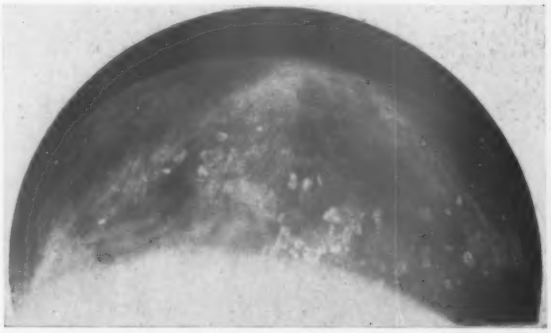

Fig. 34. Multiple calcifications are seen in the lining of the milk ducts. They must not be confused with those described herein as pertaining to malignant tumors.

present certain diagnostic difficulties, although frequently they have parallel or circular borders, depending upon the roentgenographic projection, and a certain tendency to converge towards the nipple when the process is generalized.

FIG. 35. Calcifications in the mammary arteries.

Calcifications in breast tumors have been recognized by pathologists; in our circles, Professor Carlos M. Domínguez and Dr. A. Lucas in 1930 had observed them on a roentgenogram of an operative specimen of the breast with papillary epithelioma; but until the present time they have not been given the extraordinary diagnostic value which we now attribute to them.

The fact that no tumor is seen on the roentgenogram has no diagnostic value, as some forms exist without roentgenographic visualization. In general, when no roentgenographic image is visualized coincident with a palpable tumor we advise that an exploratory biopsy be carried out without delay.

SUMMARY

A new roentgenographic sign demonstrable in many cases of malignant tumor of the breast is presented. It consists of multiple, punctate calcifications lying within, within and outside of, or entirely outside of a tumor shadow. They differ essentially from the convergent arrangement seen with lactiferous duct encrustations from blood vessel wall calcific deposits and from the coarser, fewer and sometimes peripherally distributed calcific deposits in fibroadenomas. A special low voltage roentgenographic technique with craniocaudal projection is required, best with the patient standing. Attention is also drawn to the differential roentgenographic aspects of benign and malignant breast tumors, aside from the frequently encountered calcifications.

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CHRONIC POISONING DUE TO EXCESS OF VITAMIN A

Description of the Clinical and Roentgen Manifestations in Seven Infants and Young Children

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DURING 1945 the author observed a girl 25 months of age who had cortical hyperostoses in many sites of the skeleton. Her disease began when she was 19 months of age. She was described as a probable example of infantile cortical hyperostosis,[1] although at that time there was some question of the validity of including in the syndrome of infantile cortical hyperostosis, patients such as this one who exhibited neither facial swellings nor mandibular hyperostoses and in whom the onset appeared after the first four months of life. Later it was learned that this patient had been taking one teaspoonful of oleum percomorphum daily for "several months" before the symptoms appeared. The author now has records of seven patients who ingested excessive amounts of vitamin concentrate A and D over long periods and who present similar clinical, roentgenographic and chemical findings. The subject of this report is a description of the toxic signs and symptoms in this group. The morbid anatomy of the lesions is unknown; there have been no biopsies or necropsies.

CASE REPORTS

Case 1. A. M., a girl 25 mo. of age, had complained of anorexia for 6 mo. and pain in the legs for 4 mo. She had been well until the 19th mo. when she became fussy, tired easily and began to refuse most of the food offered. During the 21st mo. the left shank and foot became swollen and painful; she refused to walk and the left shoe could not be worn because the foot was too large and tender. On several occasions she had heavy sweats at night.

Physical examination disclosed malnutrition, dry cracked lips, bilateral palpable clavicular swellings, and a tender firm swelling in front of the left tibia. These swellings were all deep, firm, not overly warm, not discolored and unattached to the skin. There was a similar swelling in the left foot. She refused to stand or to walk. Liver was not enlarged to palpation. She was and remained afebrile.

Hemogram and urinary examinations were normal. Blood proteins were present in normal concentrations (albumin 4.6 gm., globulin 2.3 gm./100 cc.), as were the serum calcium and phosphorus (10.6 mg. and 4.3 mg./100 cc., respectively). Blood NPN was 34 mg./100 cc. Serum phosphatase activity equaled 18 Bodansky units. ESR was 22 mm. in 1 hr. (Westergren). Blood serum gave a nonsyphilitic reaction to Kline's test. No serum agglutinins for the typhoid-dysentery-cholera group of bacteria were found in dilutions of 1:20 or higher.

Roentgen examination of the skeleton revealed cortical hyperostoses in both clavicles, in the right and left 7th ribs, both ulnas, right femur, left tibia, right fibula, and in all of the metatarsals in both feet, save the 1st metatarsals (Fig. 1). The mandible and the cranium were normal roentgenographically. There were no destructive changes anywhere in the skeleton and the bones unaffected by hyperostosis were all normal. Maturation of the skeleton was normal.

The course in the hospital was striking. At first all food was refused and the patient was inactive, apparently from painful pseudoparalysis associated with the tender swellings in the legs and feet. After a few days she was feeding herself and taking a normal diet in normal amounts. At the end of about 4 days, most of the pain and tenderness had subsided although the swellings persisted. A bone biopsy

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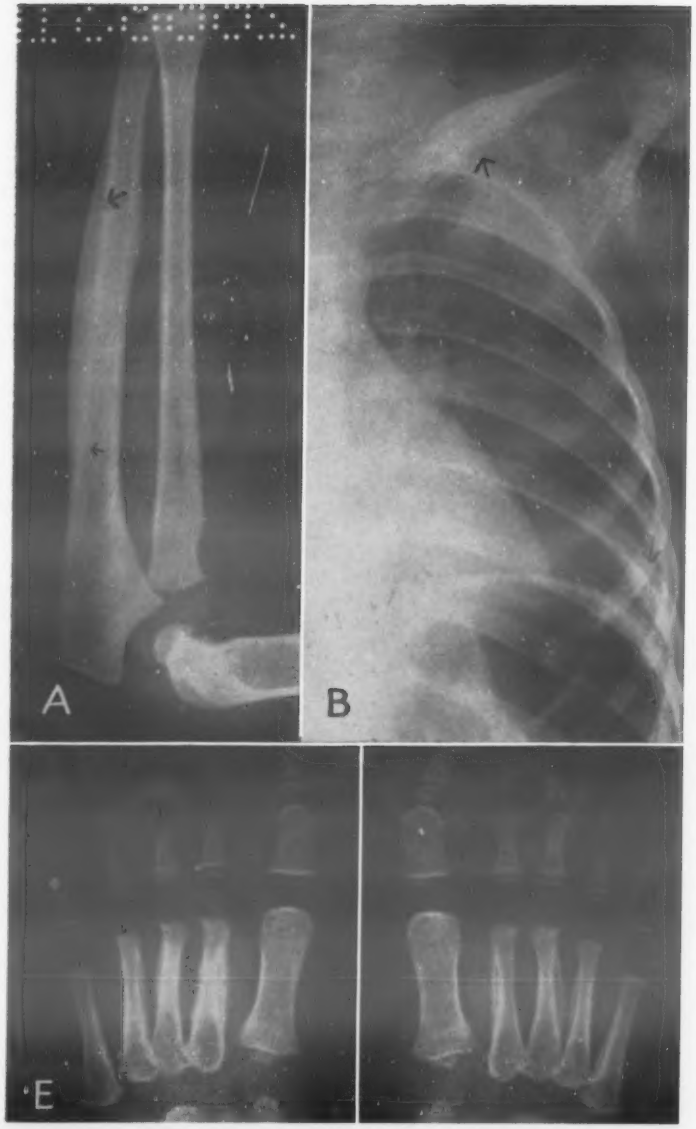

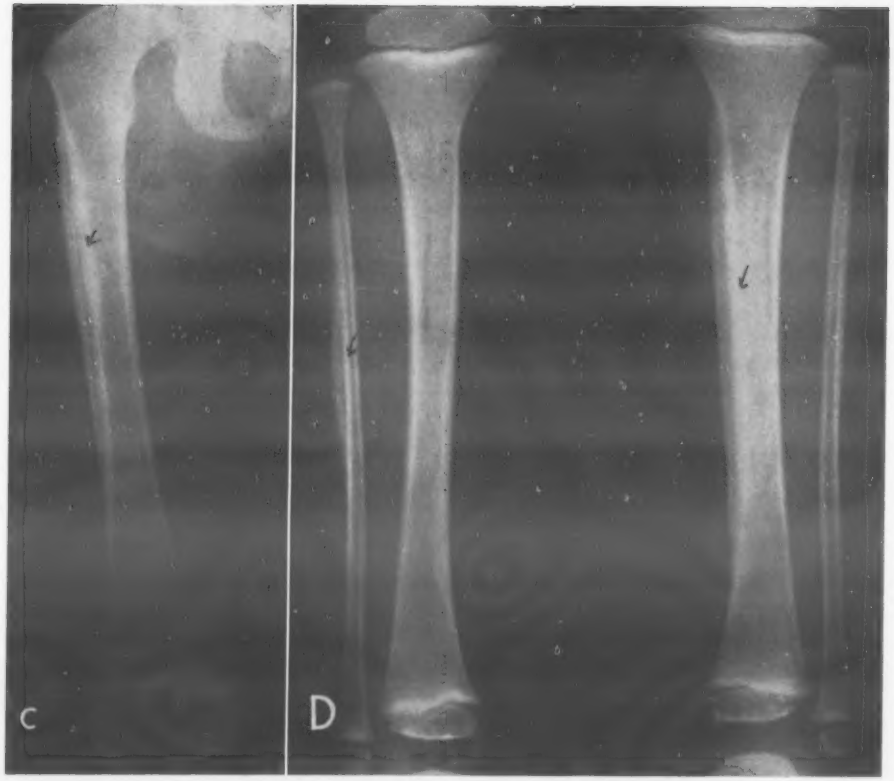

FIG. 1. (Case 1). Multiple cortical hyperstoses in A. ulna; B. L. clavicle and L. 7th rib; C. R. femur; D. L. tibia and R. fibula; E. 2nd, 3rd, 4th and 5th metatarsals in both feet. First metatarsals are not affected.

had been planned but this was cancelled owing to the rapidity of recovery.

During the 2nd wk. of hospital residence it was learned from the mother that she had voluntarily increased the dose of oleum percomorphum* several months before so that the child had been receiving daily approximately 150,000 u. vitamin A and 22,000 u. vitamin D. she was first seen in consultation with her pediatrician who had made a diagnosis of infantile cortical hyperostosis. She had been well until the 19th mo. when she became restless and "whiny" and a painful tender lump appeared on her right shin. For 3 wk. she had been refusing food and was unwilling to walk. Penicillin intramuscularly did not modify these

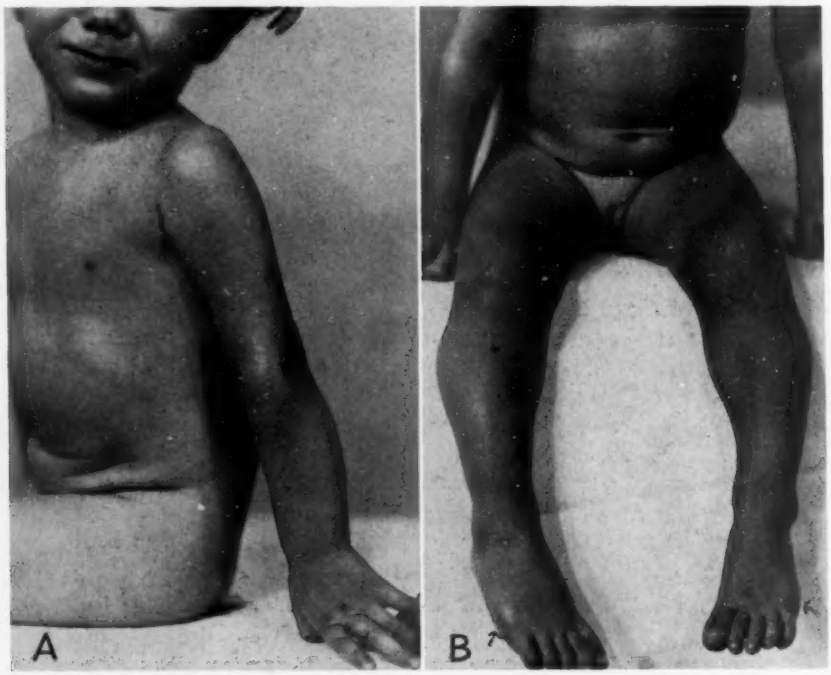

FIG. 2 (Case 2). Tender swellings and hyperostoses after 9 mo. of ingestion of excessive amounts of oleum percomorphum ®. A. Ulnar swellings in forearms and fissuring of lips; B. symmetric swellings over 5th metatarsals and over R. tibia.

This dosage had been stopped on admission to the hospital and clinical improvement was almost immediate.

After 22 days of hospital residence the patient was discharged asymptomatic. In roentgen films made 3 mo. following discharge, the hyperostoses were still visible but were all smaller and more sclerotic than before. One year later the hyperostoses were invisible roentgenographically. She has had no recurrence of symptoms for 4 yr.

Case 2. B. K., a girl, was 21 mo. of age when manifestations. At the same time she became hyperirritable; insomnia was marked and she sweated excessively at night. She screamed when the weight of the bed clothes was on her, and resisted attempts to dress her, put on her shoes or change the diaper. Two weeks before, tender swellings first made their appearance in the left forearm and on the dorsum of the right foot. One week prior to the consultation a large hard lump appeared over the occiput but there were no facial or mandibular swellings. The temperature never exceeded 37.8°C.

In the physical examination the 21st mo., she was found to be exceedingly irritable and apprehensive of being touched. Photographs and roentgen films were made with great difficulty. The lips, especially the lower lip, were dry and cracked. Deep, firm, tender swellings

* Oleum percomorphum (Mead Johnson) is made up of liver oils of the percomorph fishes, viosterol and other fish oils. It is standardized to contain not less than 60,000 u. vitamin A and 8,500 u. vitamin D/gm.

were visible and palpable in the occipital region, in both forearms, on the ventral surface of the right shank, and in the lateral aspects of the dorsum of both feet (Fig. 2A and B). Liver was not enlarged and temperature was normal.

Hemogram and urinary findings were normal. ESR was 24 mm. after 1 hr. Multiple cortical hyperostoses were demonstrated by roentgenographic examination in both ulnas, left tibia and in both 5th metatarsals (Fig. 2C, D and E).

Fig. 2 (Case 2). Tender swellings and hyperostoses after 9 mo. of ingestion of excessive amounts of oleum percomorphum ®. C. long wavy cortical hyperostosis of ulna; D. symmetric thickenings of cortices of 5th metatarsals; E. long wavy cortical hyperostosis of R. tibia; striking absence of metaphyseal and epiphyseal changes.

Mandible was normal and there was no sign of bone production under the large swelling in the occipital region. The mother on being questioned in more detail about vitamin intake related that she had been giving the patient 1 teaspoonful of oleum percomorphum daily since the 12th mo. of life, which meant that this child had received 200,000 to 300,000 u. vitamin A daily over a period of about 9 mo. Blood withdrawn at this time showed a concentration of 330 u. of vitamin A/100 cc. plasma (normal 50–150); blood carotene was 70 gammas/100 cc. (normal 40–200 gammas).

Oleum percomorphum was stopped and within 4 days the patient was asymptomatic, although swellings were still present. She began to take normal amounts of food; the pain, tenderness and hyperirritability disappeared completely and sleep was undisturbed. The swellings gradually diminished in size so that they could not be detected after about 2 wk. In films, the hyperostoses in the 5th metatarsals were barely visible at the end of 6 wk. although, at the same time, the ulnar and tibial hyperostoses were only slightly diminished in size and much denser than earlier. At the end of 1 yr., all the hyperostoses were invisible save slight residual thickening in the cortical walls of the ulnas and the right tibia. The patient has thrived during the last 23 mo.

Case 3. H. A., a boy 12 mo. of age, was referred for roentgenographic examination with the clinical problem of soreness of the left shoulder and swelling and failure to use the left arm. These symptoms had been present for approximately 3 wk. The referring pediatrician suspected unrecognized traumatic injury to the left shoulder joint. There were no constitutional symptoms; the appetite had remained good and there had been no fever.

Roentgenographic examination disclosed ulnar hyperostoses (Fig. 3). Remainder of the skeleton, including the mandible and bones of the feet, were normal roentgenographically at this time. A presumptive roentgen diagnosis of hypervitaminosis A was made on the basis of the symmetric ulnar hyperostoses and, on direct questioning, the father stated that the infant had been receiving 2 teaspoonfuls of oleum percomorphum daily during the preceding 6 mo. (400,000 to 600,000 u. vitamin A/day). The family pediatrician later reported that the mistake in dosage was due to error in purchase at the drug store. The mother had supposed she was getting cod liver oil and the druggist was under the impression that she ordered oleum percomorphum.

Infant was well nourished, without pallor or fever. There were many large and small patches of erythema in the skin and in these areas numerous scratch marks were present. Pruritus had not been recognized by the parents. In the left forearm there was a long, poorly defined, firm tender swelling which was not discolored or overly warm. Liver was not enlarged.

Blood count and urinary findings were normal. ESR was 24 mm. after 1 hr. Serum calcium was 9.9 mg./100 cc.; phosphorus 4.8 mg./100 cc.; serum phosphatase activity equaled 15.2 Bodansky u. Kline's test on blood serum gave a nonsyphilitic reaction. Concentration of vitamin A in blood plasma was 1384 I.U./100 cc. (normal 50–150); total blood lipid was 840 mg./100 cc.; blood carotene concentration equaled 146 gammas/100 cc. (normal 40–200).

The ingestion of vitamin concentrate was stopped and pain and tenderness in the left arm disappeared after 4 days. The patient has remained asymptomatic. In films of the skeleton made 10 wk. later, the ulnar hyperostoses were still visible but were smaller and more sclerotic; in films of the feet, symmetric hyperostoses of the 2nd metatarsals were now visible although they had not been visible in the earlier films and the patient had never had signs or symptoms in the feet.

Case 4 (Dr. A. Ashley Weech, Children's Hospital, Cincinnati). W. K., a boy, was first seen at 32 mo. of age when he complained of painful feet of 3 wk. duration. Twelve days before, tender swellings appeared in the left hand, left arm and left shin. He became generally irritable but had no fever and retained a normal appetite. During the 10 days prior to admission, there had been several nosebleeds. On admission the parents stated that he had been receiving 2 teaspoonfuls of cod liver oil daily.

The boy was well nourished and mentally alert. Liver edge was at the costal margin. In the left forearm there was a long, hard, tender swelling over the ulna. The swelling was not overly warm or discolored. There were similar swellings on the left thumb, over the left 2nd metacarpal and over the left tibia. Regional lymph nodes were not enlarged. Both feet and

one wrist were also slightly swollen. There was no reaction of the skin to tuberculin or histoplasmin.

Findings in the blood count and urine were normal. Kahn's test on the blood gave a non-syphilitic reaction. Serum calcium was 10.7 mg./100 cc.; phosphorus 4.8 mg./100 cc.; serum phosphatase activity equaled 19 Bodansky u. Blood protein nitrogen was 30 mg./100 cc.

Roentgenographic examination of the skeleton disclosed hyperostoses in the 2nd left metacarpal (Fig. 4); both ulnas, both tibias and the fibula. In the feet both 4th metatarsals were thickened. The bones of the head and chest were normal roentgenographically and maturation of the skeleton was normal.

The course in hospital was uneventful. Before discharge it was learned that the mother had been giving the child oleum percomorphum instead of cod liver oil. Three years later the history was reviewed again with the mother. In review she stated that 10 drops of oleum percomorphum® were given daily from the 6th wk. until the 17th mo. of life. During the 17th mo., the child had a severe laryngotracheitis and the mother, deciding that more vitamins would be beneficial, increased the dose to 1 teaspoonful of oleum percomorphum daily. This dose had been continued during the 15 mo. which preceded admission to hospital.

Fig. 3. (Case 3). Bilateral ulnar hyperostoses, 3 wk. after onset of soreness in arms, and after 12 mo. of intake of 2 teaspoonfuls of oleum percomorphum daily. Remainder of skeleton was normal roentgenographically, including feet. However, 10 wk. later and 10 wk. after oleum percomorphum had been stopped, symmetric hyperostoses of 2nd metatarsals were demonstrated roentgenographically.

Case 5 (Drs. S. Z. Levine and John Dale, Jr.,

Fig. 4. (Case 4). Cortical thickenings of 2nd metacarpal 3 wk. after appearance of tender swellings in hand. This patient had received 1 teaspoonful of oleum percomorphum daily for 15 mo.

New York Hospital, New York City). A. C., a boy 18½ mo. of age, was admitted with a chief complaint of pain in the bones of a few weeks' duration. Appetite had always been poor. Drisdol® with vitamin A,* a vitamin concentrate of A and D, had been started at 1 wk. of age when a "dropper-full" was given daily. After the 12th mo., the vitamin concentrate was increased to ½ and later ¾ teaspoonful daily, which provided about 125,000 u. vitamin A and 20,000 u. vitamin D. After the 13th mo., 1 teaspoonful of drisdol® with vitamin A (about 250,000 u. vitamin A and 40,000 u. vitamin D) was given daily. Two weeks before admission he was said to have bruised his leg in a fall and had had pain in his legs.

Examination disclosed that he was hyperirritable and afebrile. Both hands were swollen and tender. Liver edge was 2 cm. below the right costal margin. Left shank and both forearms were swollen and tender.

Hemogram and urinary findings were normal. ESR was 27 mm. after 1 hr. Serum calcium was 10.5 mg./100 cc.; serum phosphorus 3.6 mg./100 cc.; serum phosphatase activity equaled 9.7 Bodansky u. Vitamin A concentration in the blood plasma was 1395 u./100 cc. (normal 80–200); blood carotene was 73 gammas (normal 50). Vitamin C content of the leucocytes was 4.2 mg./100 cc. (low). The

* Drisdol® with vitamin A is a solution in sesame oil of drisdol, vitamin D_2 from ergosterol, and natural fish liver oils. Each gram contains 50,000 u. U.S.P. vitamin A and 10,000 u. vitamin D.

Fig. 5 (Case 5). Multiple cortical hyperostoses after 10 mo. of ingestion of excessive amounts of drisdol ® with vitamin A, ½ to ¾ teaspoonful daily: A. in both ulnas and one radius. B. in L. tibia and R. fibula; arrow on right points to cortical defect not related to hypervitaminosis A.

Mazzini blood test gave a nonsyphilitic reaction.

Roentgenographic examination of the skeleton disclosed cortical hyperostoses in both clavicles, 6th and 7th right ribs, both ulnas, right radius, left tibia, right fibula, 4th and 5th right metatarsals and both 4th metacarpals (Fig. 5). Mandible was normal, as was skeletal maturation.

In the hospital the daily vitamin intake was reduced to approximately 12,000 u. vitamin A

the forearms, especially on the right side. One month later his shanks and ankles became swollen. At this time roentgenographic examination had shown symmetric hyperostoses in the ulnas. The feet and ankles became so swollen and tender that he could not wear his shoes. Immediate roentgenographic examination then disclosed no abnormal changes in the bones of the feet or shanks. During the first weeks of the illness, fever occurred for short periods and then disappeared completely.

Fig. 6 (Case 6). Lamellated cortical hyperostosis of L. 5th metatarsal 9 mo. after beginning ingestion of ½ teaspoonful of oleum percomorphum daily. Two ulnas were only other bones affected.

Fig. 7 (Case 7). Symmetric bilateral thin hyperostoses of ulnas after 15 mo. of ingestion of excessive amounts of navitol ® in daily dosage of 1 teaspoonful, which provided approximately 200,000 u. vitamin A daily. Both clavicles were also thickened.

1,800 u. of D and 50 mg. ascorbic acid. Clinical recovery was rapid. He became active and asymptomatic; after 6 wk., he had gained 0.5 kg. The plasma concentration of vitamin A fell to 700 I.U. on the 12th hospital day, 500 I.U. on the 20th hospital day, 400 I.U. on the 27th day and 360 I.U. on the 37th hospital day.

Case 6. R. B., a boy 24 mo. of age, complained of pain, tenderness and swellings of the extremities for about 2 mo. According to his mother, he had always been in good health prior to the present complaints and had been taking the "usual" amounts of vitamin concentrates. The first symptoms were pain and swellings in

When examined by the author 2 mo. after onset, there were no abnormal physical signs. The swellings could not be identified clinically. In the roentgenographic examination, however, cortical thickenings were visible in both ulnas and in the 5th metatarsal (Fig. 6).

The family was requestioned 2 yr. later and it was then learned that the mother, who had given the original history. had had little to do with the care of the child during his 1st 2 yr. Actually he had lived with and been under the care of his grandmother. She stated that oleum percomorphum had been given daily since the first weeks of life, starting with a few drops daily with gradual increases to ½ teaspoon daily.

During the 7 mo. prior to onset of symptoms, the boy received approximately 100,000 u. vitamin A every day.

After a few days of hospital residence, the patient went to live with his mother and remained permanently asymptomatic.

Case 7 (Dr. Frederic N. Silverman, Children's Hospital, Cincinnati). R. B., a boy 37 mo. of age, had had a pruritic rash on his buttocks and back for 5 mo. His arms and legs had been tender for 2 mo. He frequently limped and refused to bend over owing to pain. He had been afebrile. His skin was dry and contained many scratch marks. The liver edge was 3 cm. below the right costal margin. He whined with pain when manual pressure was made on his legs and arms, especially when deep palpation was attempted. Blood count disclosed a mild anemia; there were 9 thousand leucocytes/cmm. with normal differential count. Serum calcium was 10.8 mg./100 cc.; serum phosphorus 5.2 mg./100 cc.; phosphatase activity of the serum equaled 22 Bodansky u. Roentgenographic examination of the skeleton disclosed cortical hyperostoses in both clavicles and both ulnas (Fig. 7). The bones of the feet were not filmed.

The cause of these clinical manifestations and roentgen changes remained unexplained until 4 yr. later when the mother was requestioned concerning the patient's intake of vitamin concentrates. The mother referred to the written records in her baby book and then stated for the first time that navitol®,* a concentrate of vitamins A and D, had been started on the 10th day of life and 10 drops daily had been given until the 20th mo. During the 20th mo., the child suffered from a respiratory infection and the mother increased the dosage of navitol® to 1 teaspoonful daily (200,000 to 300,000 u. daily vitamin A). This excessive intake had been continued for 17 mo. prior to admission to the hospital. The patient recovered quickly in the hospital and has remained well for the ensuing 4 yr.

COMMENT

Acute poisoning due to the ingestion of large single doses of vitamin A is rare but has occurred occasionally when children have swallowed an entire (50 cc.) bottle of oleum percomorphum.[2] Under these circumstances, the only clinical manifestations have been transient nausea and vomiting. The toxicity of polar bear liver to Arctic travellers, Eskimos, and their dogs has long been recognized; apparently it is due to the high content of vitamin A. Poisoning from this source is said to be characterized by headache and hyperirritability during the first 24 hours, followed by an irresistible desire to sleep. Desquamation of the skin begins at the mucocutaneous junctions of the lips during the second 24 hours, with rapid spreading until the entire skin peels in a few days. Several parties of Arctic explorers have been poisoned in this fashion and a number of deaths have been reported. Rodahl[3] found the vitamin A content in polar bear liver approximated 18,000 u./gm. He estimated that the ingestion of 0.5 kg. of polar bear liver represented an intake of approximatley 8,000,000 u. of vitamin A.

Moore[3] found a wide variety of toxic manifestations in experimental vitamin A poisoning in small animals. He observed roughening of the hair, alopecia, generalized seborrhea, enteritis, pneumonia, emaciation, softening and fractures of the long bones, and sudden profuse internal hemorrhage. Wolbach[4] and Maddoch, Wolbach and Maddoch[5] made comprehensive studies of the skeletal changes produced by excess vitamin A in small animals. They report that all features of skeletal maturation are accelerated: endochondral bone formation and subperiosteal appositional growth of the cortex. The rapid and excessive tubulation of rat bones resulted in tubular bones of smaller caliber than normal, in contrast to the swollen thickened shafts which have been observed in all the human examples of clinical vitamin A poisoning. Many of Wolbach's animals, especially the younger growing ones, developed fractures after 6 to 10 days of high intake of vitamin A.

There are five examples of chronic vitamin A poisoning in infants and younger children reported in the literature. Josephs[6] first pointed out the dangers of high vita-

* A fish liver concentrate containing 65,000 u. U.S.P. vitamin A and 13,000 u. U.S.P. vitamin D/gm.

min A intake in pediatric prophylactic practice and first demonstrated the value of the increased blood content of vitamin A in diagnosis of its poisoning. He described hypervitaminosis A in a boy 34 months of age who had received one teaspoonful of halibut liver oil (240,000 u. vitamin A) daily after the third month of life and occasionally drank the oil directly from the bottle. Toomey and Morrisette[7] first observed deep, hard, tender swellings in the extremities and were the first to describe cortical thickenings in tubular bones. Their patient was a boy 23 months of age who received one teaspoonful of oleum percomorphum daily from the second week until the 19th month and two teaspoonfuls from the 19th month until the 23rd month. After stoppage of oleum percomorphum and subsidence of clinical signs, Toomey and Morrisette reinduced the clinical signs by refeeding oleum percomorphum, and then a second time by feeding pure vitamin A.

Dickey and Bradley[8] reported tender swellings and cortical hyperostoses in a child 22 months of age who was posioned by navitol® fed in daily dosage of three teaspoonfuls. Two patients of Rothman and Leon,[9] who were poisoned by excessive dosage of oleum percomorphum, exhibited tender swellings, cortical hyperostoses and high blood content of vitamin A. In all recorded cases, with the exception of the case of Josephs, rapid recovery followed the stoppage of ingestion of vitamin concentrate containing vitamin A.

In the group of seven patients reported here, the principal toxic manifestations were similar to those previously described; the roentgenographic observations are more complete and more detailed than those in earlier reports. Data in 12 cases now provide the opportunity for a more complete presentation of the clinical picture and a better insight into the differential diagnosis. Current findings in a comparatively large number of patients also make possible a comparison of hypervitaminosis A and infantile cortical hyperostosis, a syndrome with which vitamin A poisoning has been confused. It seems certain now that the two older patients described in 1946 (Caffey,[1] cases 2 and 5) as examples of infantile cortical hyperostosis actually suffered from excess vitamin A.

In all these patients, the excessive intake of vitamin A was unknown to their pediatrician and was not recorded in the original hospital histories. In three cases the history of overdosage was not obtained until two, three and four years after discharge from the hospital. Customarily, in history-taking, the interest in vitamin intake is directed exclusively at insufficiency of intake and the question of excessive intake is not raised. If overdosage is to be detected early from the history, the actual frequency of feeding and amounts of vitamin concentrate fed, the method of measuring the amount and the preparation used must all be sought for in detail. Apparently it is not an uncommon practice for mothers to stop measuring vitamin concentrate accurately, drop by drop, soon after they start its use; to save time the estimated dosage is poured directly from the bottle into a teaspoon. Under these circumstances the error of estimate appears to be invariably in the direction of overdosage. In one of the cases, the mother stated that she had been giving 20 drops of oleum percomorphum daily but, on further questioning, revealed that she had not been measuring each dose; actually she had been feeding the infant one bottle of 50 cc. of oleum percomorphum each month. The infant had received 60 to 70 drops each day instead of the 20 drops daily originally stated. Knowledge of the frequency and the amount of vitamin concentrate purchased may be more informative than the mother's statement of the unmeasured daily dose. The physician must also make certain that informants, especially fathers and grandmothers, actually know the details of vitamin feeding. The possibility of confusion between oleum percomorphum and cod liver oil at the time of purchase should also be borne in mind.

All these parents were wholly ignorant of the harmful effects in higher doses of the vitamin concentrates recommended to them in small doses for prophylaxis. The parental reasons for giving toxic doses are interesting and important. In one case, the mother simply decided that, if a small amount of the concentrate was good for the baby's bones, a larger amount would be better. One grandmother increased the dosage to make sure that she was doing a better job at prophylaxis than the mother had been doing. In two cases the reason for higher dosage was never satisfactorily explained; apparently these mothers, ignorant of potential dangers, increased dosage in the blind belief that plenty of vitamins would promote the health of their children. In two instances dosage was increased and then toxic doses were continued in the hope of combatting and preventing upper respiratory infections. In another case, not reported in this group, the mother stated that her infant had developed such a fondness for oleum percomorphum that she had to feed one teaspoonful daily to keep the baby satisfied. In another instance the mother was unwittingly feeding oleum percomorphum instead of cod liver oil.

The estimated daily intake for these patients varied from about 75,000 to about 500,000 u. vitamin A. The data in this regard are difficult to evaluate precisely. In some cases the actual dosage was underestimated by the mother. On the other hand, such factors as incomplete filling of the teaspoon, spillage during feeding and spitting out of some of the concentrate by the infant may well have lessened the actual intake and absorption in comparison with the amount fed, as stated in the history. It should be emphasized that in no case was overdosage due to erroneous advice by a physician or erroneous labelling of the bottle by the manufacturer. It is equally true, however, that in no case did a manufacturer's label state the harmful effects of overdosage nor had any mother been so advised by her pediatrician. This failure to point out clearly the dangers of excess feeding of vitamin concentrates is a serious error of omission and should be corrected.

There are several possible toxic elements in the concentrates of vitamins A and D in fish oils, which presumably might have been the toxic agents in these patients. Vitamin D is an unlikely toxic factor because it had been used clinically in considerably higher dosages without toxic effect; also when children have been poisoned by massive administration of vitamin D, they have not exhibited signs and symptoms like those in this group. According to Debré,[10] the toxic manifestations of vitamin D poisoning in children include anorexia, polydypsia, renal damage, increased blood urea and blood calcium, and extraskeletal calcifications. There are some toxic proteins in several types of fish liver, notably halibut liver; supposedly, even minute traces of the liver proteins are removed from fish liver oils in the current methods of their extraction and processing.[11] Toomey and Morrisette[7] performed the crucial clinical experiment of feeding excess of vitamin A to their patient and reproduced the clinical picture of hypervitaminosis A. These facts all indicate that the toxic component of the vitamin concentrate fed to our patients was vitamin A.

There are several characteristic features in the clinical picture. In all cases there was a long latent period of several months between the start of excessive dosage and the appearance of diagnostic clinical signs. The length of this latent period did not depend on the size of the overdose. The shortest latent period was six months; the longest was 15 months. The appearance of tender swellings has been used as the criterion for the onset of the clinical disease. In some cases pruritus and anorexia preceded tender swellings by several weeks or months; anorexia and pruritus are so common in children who do not suffer from hypervitaminosis A that their significance in children poisoned by vitamin A is exceedingly difficult to evaluate from a causal

standpoint. Since anorexia is a prominent feature of vitamin D poisoning, it is possible that vitamin D played a part in the causation of anorexia in these patients. In Case 3, however, appetite remained normal during a period of six months of excessive vitamin concentrate feeding and for three weeks after the appearance of tender swellings. Enlargement of the liver has been found by others in several patients; the liver was normal in size in all the patients examined personally.

Tender swellings, hyperirritability and limitation of motion all became evident at about the same time. Tender swellings were most common in the forearms but they were more conspicuous in the shanks and feet in some patients. Swellings were always deep and firmly attached to underlying structures, apparently the bones. The overlying skin in contrast was always freely movable over the deeper masses and was never edematous or discolored. Tenderness appeared to be moderate and local heat was not increased. All types of handling were feared and resisted. Large temporal and occipital swellings developed in two patients but the mandible and face were always normal in all patients. Lymph nodes, regional to the swellings, were not enlarged.

Hyperostoses in two or more of the long bones were identified roentgenographically in every patient; the distribution and frequency of involvement of different bones are shown in Figure 8. Hyperostoses were found under all of the soft tissue swellings which could be demonstrated clinically. All the 14 ulnas in seven patients were affected and in every patient one or more of the metatarsals were thickened. None of the 12 first metatarsals examined was involved. The high incidence of localization in the ulnas and metatarsals appears to be the most diagnostic feature of the skeletal lesions of poisoning due to excess vitamin A intake. In Case 3, metatarsal thickenings were not visible three weeks after onset when ulnar hyperostoses were demonstrated, but 10 weeks after the withdrawal of all vitamin A by mouth, both second metatarsals were found to be thickened. There is no satisfactory explanation for the high frequency in the ulnas and metatarsals; it is possible that trauma played some part in thickening these relatively exposed bones. The bones at the roots of the extremities, the femurs and humeruses, which are relatively well protected from trauma by heavy muscles were the least affected. Only one of the 14 femurs and none of the 14 humeruses showed cortical thickening.

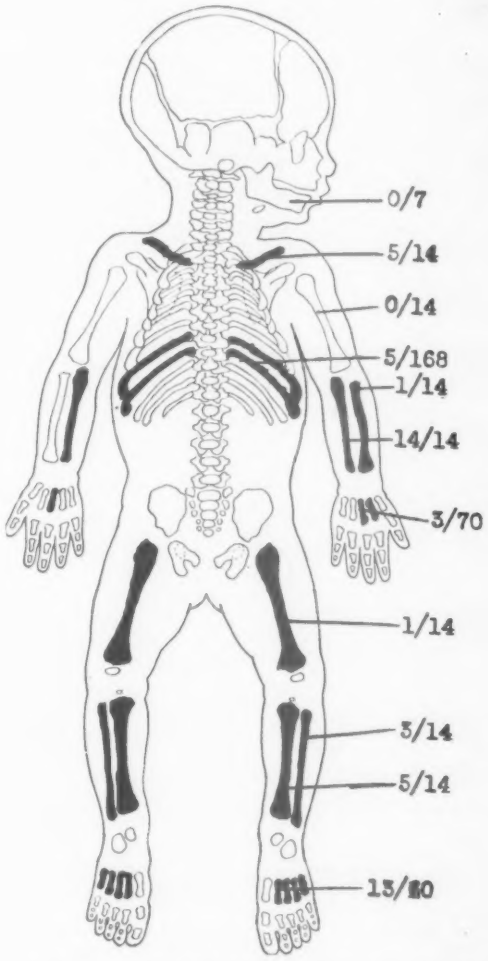

Fig. 8. Distribution of hyperostoses in 7 patients. Shaded bones were hyperostotic and numbers opposite each shaded bone indicate total number of such affected bones in all 7 patients on both sides of body. In every patient both ulnas were thickened and in every patient some of metatarsals were affected. First metatarsals, however, were not affected in any patient.

The mandibles and scapulas were normal in all patients. Five of 14 clavicles exhibited deep cortical hyperostoses.

The earliest roentgenographic observations were in Case 3 in which films showed cortical hyperostoses in the ulnas three weeks after the appearance of clinical swellings in the forearms. Early, the hyperostoses have a shell-like appearance with a zone of diminished density between the subperiosteal thin layer of bone and the external surface of the old cortex. After withdrawal of vitamin A this intermediate clear zone disappears; the hyperostoses then shrinks onto the old cortex and fuses with it (Fig. 9). These solid sclerotic cortical thickenings are in turn gradually resorbed from within but remain visible for many months after complete clinical recovery. During the reparative phase some of the hyperostoses became lamellated.

The amounts of vitamin A in the blood have been increased in all patients whose bloods have been tested. The concentrations varied from 400 to 2000 u./100 cc. It is not certain how early blood vitamin A rises, or whether it is elevated during the long latent period prior to the appearance of clinical manifestations; it is possible, however, that an excess of vitamin A in the blood might point to the diagnosis while the patient was still asymptomatic. Following the stoppage of ingestion of excessive vitamin concentrate, vitamin A levels in the blood fell gradually and did not return to normal levels for several weeks (Case 5; Toomey,[7] Dickey[8] and Rothman[9]).

Fig. 9. Healing of ulnar hyperostosis in Case 2. A. Thin, wavy, shell-like cortical thickening during active phase of poisoning at admission. B. Four months after stoppage of vitamin concentrate; same hyperostosis is shrunken, smooth and more sclerotic.

The rapid and complete clinical recovery of these patients after the stoppage of overdosage is one of the most distinct and convincing features of the syndrome. In patients observed personally, tenderness,

pain, hyperirritability and anorexia have disappeared completely within one week. Recovery is comparable to the recovery in scurvy following the administration of vitamin C. In Case 1, recovery was so rapid after admission to the hospital that a bone biopsy which had been scheduled was cancelled.

As mentioned earlier, hypervitaminosis A has been confused by the author with infantile cortical hyperostosis. Personal communications from several sources indicate that this continues to be a not infrequent diagnostic error. Actually there are but two features which are common to both disorders; cortical hyperostoses and tender soft tissue swellings. In contrast, there are several outstanding differences which readily identify hypervitaminosis A and infantile cortical hyperostosis as separate entities. Infantile cortical hyperostosis has always made its appearance during the first four months of life and in one case was present on the first day of life; in hypervitaminosis A, on the other hand, diagnostic clinical signs have never been recognized prior to the 12th month of life. It is interesting that there is no recorded example of onset between the 5th and 11th months in either disorder. The face and jaw have been swollen and the mandible has been thickened in every case of infantile cortical hyperostosis; these structures have not been affected in a single case of hypervitaminosis A. Metatarsal hyperostoses have been present in every case of vitamin A poisoning in which the feet have been examined roentgenographically but have been demonstrated in only one case of infantile cortical hyperostosis. The blood vitamin A has been increased in hypervitaminosis A in every patient tested; blood vitamin A levels were normal in the only six patients with infantile cortical hyperostosis so tested. Fever is the rule in infantile cortical hyperostosis (15 of 17 cases); fever, other than transient fever due to respiratory infection, was absent in all cases of hypervitaminosis A.

Excessive intake of vitamin concentrate A and D preceded poisoning by vitamin A in all cases; vitamin intake has apparently not been excessive in any cases of infantile cortical hyperostosis. Also the feeding of excessive vitamin concentrate A and D during the first four months of life has not produced the manifestations of infantile cortical hyperostosis.[6,7,9] It seems likely that impaired absorption of vitamin A in oil during early life[12] is responsible for the absence of toxic symptoms in babies fed large amounts of oleum percomorphum during the first months of life. Recovery from vitamin A poisoning is dramatically rapid after admission to hospital and stoppage of the excessive ingestion of vitamin A; in contrast, the signs and symptoms of infantile cortical hyperostosis have continued and exacerbations have occurred weeks and months after hospital entry when it was certain that there was no excessive ingestion of vitamin A. Scapular lesions are unknown in vitamin A poisoning; they have been present in several cases of infantile cortical hyperostosis. Soft tissue swellings in the latter disease are usually much larger and more tender and the edges of the hyperostoses are much rougher than their counterparts in hypervitaminosis A.

SUMMARY AND CONCLUSIONS

The clinical manifestations, the roentgenographic changes in the skeleton and the elevation of blood vitamin A are reported in a group of seven infants and younger children poisoned by ingestion of excessive quantities of vitamin concentrates A and D over periods of several months.

The differential features of vitamin A poisoning and infantile cortical hyperostosis are discussed.

Three types of vitamin concentrate A and D, commonly used in routine pediatric prophylaxis, were found to be toxic when ingested in sufficiently large quantities over sufficiently long periods. The minimal preclinical latent period of vitamin A poisoning was about six months and the minimal toxic daily dose was about 75,000 units.

Excessive dosage was due to overenthusiasm for vitamins and ignorance of the dangers of high vitamin intake.

The hazards of vitamin A poisoning from the routine prophylactic feeding of vitamin concentrates A and D to healthy infants and children on good diets are considerably greater than the hazards of vitamin A deficiency in healthy infants and children not fed vitamin concentrates.*

ADDENDUM

Since this manuscript was submitted for publication, two additional cases of vitamin A poisoning have been described (Fried, C. T., and Grand, M. J. H., Hypervitaminosis A, Am. J. Dis. Child. **79**: 475, 1950). The clinical, chemical and roentgen findings are all similar to those in the other reports. A total of 14 cases of infantile and juvenile poisoning due to vitamin A have now been recorded.

More recently a 15th example of vitamin A poisoning has been recorded (Wyatt, T. C., Carabello, C. A., and Fletcher, M. E. Hypervitaminosis A; report of a case, J.A.M.A. **144**: 304, 1950).

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* For discussion see page 39.

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SKELETAL AND PERIARTICULAR MANIFESTATIONS OF HYPERVITAMINOSIS D*

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INTRODUCTION

THE fact that excessive amounts of vitamin D may induce a characteristic disease syndrome is now well established. During the past few years the widespread and indiscriminate therapeutic use of highly potent ergosterol derivatives has resulted in the publication of numerous case reports illustrating the toxic effects of overdosage.[3,14,17,31,32,35,45,46,48,58,60,65] The presence of abnormal deposits of calcific density has been a common clinical feature of these cases. Almost all parts of the body have been involved. Despite this fact the disease and its manifestations have attracted little roentgenological attention. It is the purpose of this paper to present several cases displaying unusual skeletal and periarticular manifestations of hypervitaminosis D which are believed to be of diagnostic significance. Although these specific manifestations have been mentioned in previous publications, they have never been presented as a significant entity, or their differential diagnosis considered.[19,35,39,46]†

The development of toxic effects from vitamin D requires very high dosage and, therefore, highly potent preparations. Although some attention had been paid to possible toxic effects of cod liver oil after discovery of its antirachitic properties, no dramatic results were obtained and the existence of a true hypervitaminosis remained questionable.[2,38] In 1924 Hess[29] and Steenbock and Black[55] independently demonstrated the antirachitic activation of sterols by irradiation. Shortly thereafter preparations of irradiated ergosterol with extremely high antirachitic activity became readily available. Animal experiments almost immediately demonstrated toxic effects from high dosage, and calcification was noted to have occurred in blood vessels, heart muscle, lungs, kidneys and urinary tract.[10,22,24,25,36,41,49] Reports of toxicity in humans soon appeared (see above). The number of cases was small, however, until large doses of vitamin were advocated in the therapy of various allergic and arthritic conditions.[20,42,51,52,54] Although opinions as to its therapeutic effectiveness varied considerably, large amounts of various synthetic preparations of the vitamin were used. Dosages up to 500,000 units per day were advocated. A definite increase in the number of reported cases of toxicity followed. The usual syndrome resulting from excessive dosage has been well described and is fairly typical.[15,16,43,61] The clinical picture appears to depend upon elevation of the serum calcium and phosphorus. Symptoms consist of nausea, urinary frequency, polydypsia, diarrhea, gastrointestinal pain and vomiting. Renal damage and metastatic calcification are very common sequelae. Many deaths have been reported.

The most important roentgenological manifestations of this disease are dependent upon the metastatic calcification and are, therefore, of secondary importance in most instances. However, abnormal calcium deposits occur in almost every case, and, because of this, have been widely reported. The major arteries, vessels of extremities, heart (endocardium, atrium, cardiac muscle, valves), lungs (alveoli and bronchi), kidneys (parenchyma and lumina), gastric mucosa, pancreas, articular

† Since preparation of this paper, a case of hypervitaminosis D showing periarticular calcification has been published as a case record of the Massachusetts General Hospital (*New England J. Med.*, Sept. 14, 1950, *243*, 418).

* Presented at the Fiftieth Annual Meeting, American Roentgen Ray Society, Cincinnati, Ohio, Oct. 4–7, 1949.

bursae, skin, subcutaneous tissue, muscle, sclera, falx, choroid and dura have all been described as being involved.[17,21,23,32,35,45,46,58,65] The skeletal system has been variously described as decalcified* and of increased density on the same dosage.[18,32,45,54,61]

None of the calcifications has appeared with sufficient consistency to be of diagnostic value. Moreover, the majority may occur as manifestations of other disease syndromes or merely as incidental findings in otherwise normal individuals. Diagnosis, therefore, is dependent upon other studies. Thus far no valid criteria for a roentgenological diagnosis of this disease have been established. As a matter of fact the syndrome has attracted little attention in the roentgenological literature. The 5 cases to be presented below are believed to present certain features of a peculiar and perhaps diagnostic character. It is also hoped that they will direct attention to a disease which is of considerable roentgenological interest and which has been generally neglected.

CASE REPORTS

CASE 1. A. R. (This case is also described in a paper by Kattwinkel and Adams which is to appear in a future issue of the *Journal of Bone and Joint Surgery*.) This patient, a sixty-two year old school teacher, entered the Newton-Wellesley Hospital with an eight week history of anorexia, weight loss, nausea and vomiting. The present illness dated back twenty years at which time she developed a painful, swollen, right knee. A diagnosis of rheumatoid arthritis was made. The knee was treated symptomatically and slowly improved. Thereafter, she experienced various periods of exacerbation and remission of rheumatoid activity, and received such treatment as mineral baths, fever therapy and colonic irrigation. Five years before admission and after both wrists and the digits, as well as the right knee, had become involved, she began to take vitamin D (ertron) at the rate of 150,000–200,000 units per day. It was taken regularly with the exception of occasional lapses of three to four weeks until the time of hospital admission.

Two years before admission she began to suffer from frequency and was said to have nephritis. Further clinical information on this aspect of her disease is lacking, but it is of interest to note that a hospital record one year prior to initiation of vitamin D therapy states that urinalyses were normal. Within the next year her right knee had become so painful that she could not walk and she developed painful swellings on both shoulders. Three months before entry both ankles became swollen and painful. In the eight weeks prior to admission the patient had vomited once or twice daily and lost about 20 pounds in weight.

Physical Examination. The general appearance was that of an elderly, poorly nourished, sickly woman. General examination was essentially negative except for a blood pressure of 182/110 and a pulse rate of 120. Each shoulder was involved by a separate, cystic tumor mass measuring approximately 8 cm. in greatest diameter. Both wrists were swollen. An obvious cystic tumor mass was present over the head of the first metacarpal on the left. The typical ulnar deviation and flexion deformities of the fingers were present bilaterally. There was a round swelling at the tip of the right index finger. The right knee was swollen and showed a definite genu valgum deformity. Both ankles were enlarged. A cystic tumor mass was present over the right ankle.

The nonprotein nitrogen was 49 mg. per cent and the specific gravity of the urine was fixed. The initial serum calcium was 9 mg. per cent but numerous repeat examinations gave values of 15 and 6 mg. per cent respectively for calcium and phosphorus.

Films of both shoulders showed large, smoothly outlined, lobulated masses of calcium in the soft tissues above and lateral to the shoulder joints. Some of the calcium appeared to be in large, thin-walled sacs while other deposits were in conglomerate masses. There was marked resorption of both acromion processes and the distal end of each clavicle. Films of

* According to Dr. S. B. Wolbach, the words "decalcification" and "demineralization," as referred to roentgenograms of living bone, are misnomers. He insists that living bone is not decalcified but is absorbed through the action of osteoclasts. The matrix of the bone disappears along with the calcium salts in such conditions as "disuse atrophy," and in some of the various experimental conditions of avitaminosis and hypervitaminosis.

"Osteoporosis," as defined by Fuller Albright, is due to the inability of the organism to form and lay down the protein matrix of bone. If the organism is unable to deposit calcium in the matrix, the resulting condition is "osteomalacia." Excessive loss of calcium by the organism in such conditions as hyperparathyroidism, results in "osteitis fibrosa cystica." In hypervitaminosis D, the process is, therefore, one of bone absorption and not simple decalcification.

Fig. 1. Case 1. Roentgenograms illustrating typical periarticular calcification with absorption of normal bone. (*A*) Right shoulder. (*B*) Left shoulder. (*C*) Right ankle. (*D*) Right knee.

elbows, wrists, knees and ankles showed similar massive deposits of calcium in and around the joints, in the bursae and along the tendon sheaths. The left knee showed slight involvement while the right knee showed massive involvement (see Fig. 1). The calcification along the tendon sheaths was particularly marked around the ankles. There was marked rarefaction of all the bones.

Vitamin D therapy was immediately discontinued and the patient placed on a low calcium diet.

The cystic tumor mass over the left shoulder was explored surgically. Incision through the skin revealed a pink, glistening capsule. When this was sectioned, yellowish granular material oozed forth from a loculated interior. The cyst wall seemed to be confluent with the joint

capsule; it was impossible to distinguish between them grossly. The pathologist's report described the changes as those of a nonspecific, benign, inflammatory or degenerative lesion containing large amounts of lipid and calcific granules and large plaques of calcific debris.

Roentgen findings one year after the original admission and one year after discontinuing vitamin D therapy were as follows: Re-examination of the left shoulder showed marked decrease in the soft tissue calcium deposits, some healing of the normal bone. The other involved joints showed similar improvement with absorption of the abnormal calcium deposits and recalcification of the involved bones. Numerous small cystic areas of calcification appeared in the medullary cavity of the right humerus (Fig. 2).

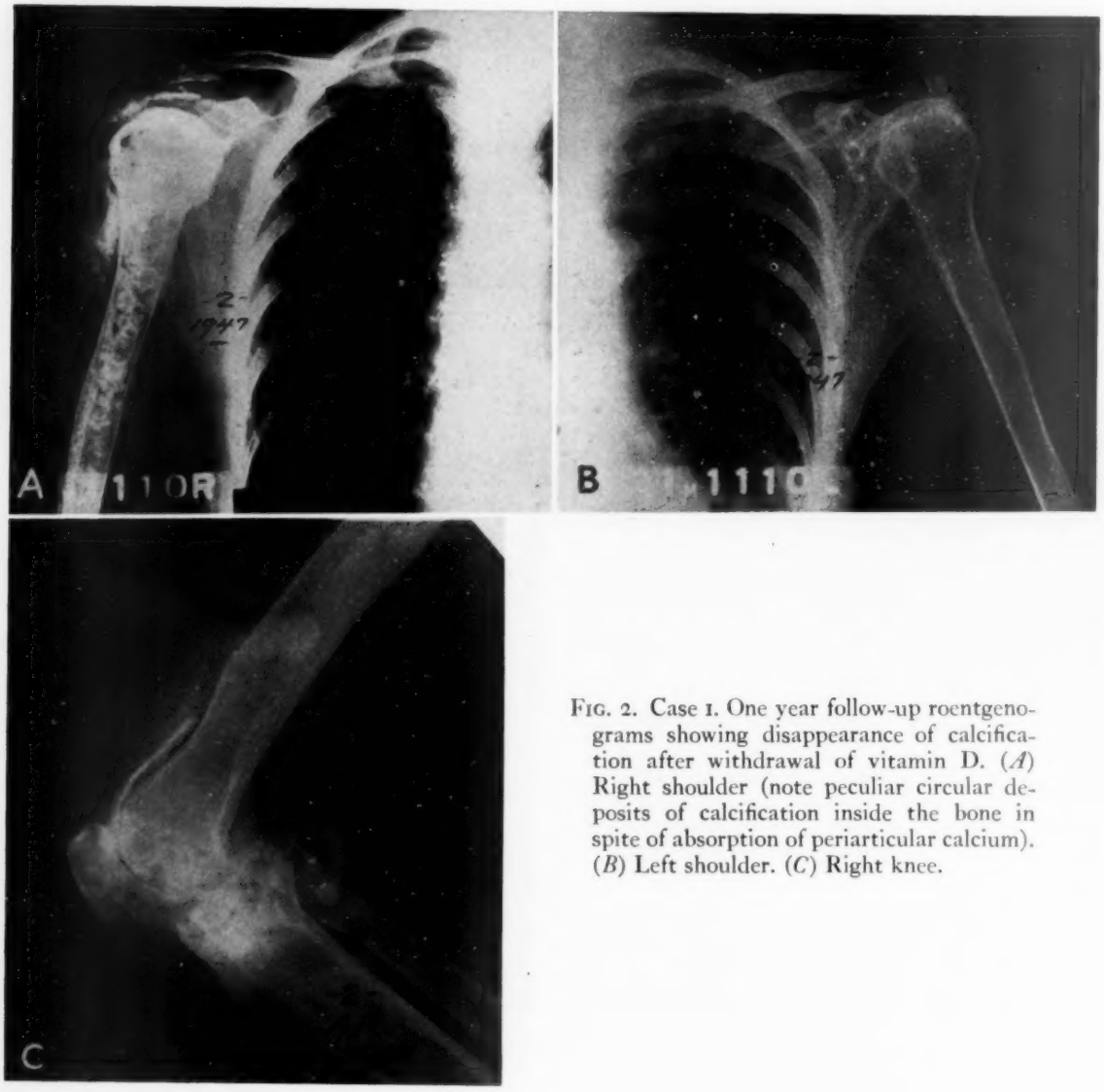

FIG. 2. Case 1. One year follow-up roentgenograms showing disappearance of calcification after withdrawal of vitamin D. (*A*) Right shoulder (note peculiar circular deposits of calcification inside the bone in spite of absorption of periarticular calcium). (*B*) Left shoulder. (*C*) Right knee.

The patient was discharged after six weeks. She was forced to lead a chair existence because of inability to bear weight on the right leg. At the end of one year the cystic tumor masses of hands, shoulders and right knee had almost disappeared. However, the ankles continued to be swollen and the nonprotein nitrogen remained elevated.

The patient died shortly thereafter and was autopsied. Pathological diagnoses were as

follows: arteriosclerotic heart disease; myocardial fibrosis—old and recent infarction; chronic pyelonephritis; arthritis with multiple deformities involving particularly fingers, toes, wrists, left elbow and right knee; periarthritic calcification and fibrosis, decalcification and cyst formation of right humerus consistent with hypervitaminosis D.

Case II. A.W.* This twenty-nine year old, unmarried, male, poultry farmer entered the hospital with a six year history of pain and swelling in ankles, knees and shoulders. These symptoms had been of such severity as to cause him serious difficulty in locomotion and had finally forced him to lighten his work load. For three years immediately prior to entry he had been taking gelatabs (Upjohn), three per day (150,000 units of vitamin D). During the last six months he had developed swellings in both wrists and over the low back and such unrelated symptoms as urethral pain, intermittent hematuria, nocturia, deafness, weakness and fatigue.

Physical examination revealed a thin, partially deaf male with numerous cystic, subcutaneous nodules over both wrists and the sacrum. There was a dorsal kyphosis with limitation of motion in the shoulder girdle. The fingers were weak and flexion was limited.

The urine showed a specific gravity ranging from 1.005 to 1.008, 2 plus albumin, and was intermittently loaded with red blood cells. Phenolsulfonphthalein excretion was 4 per cent at the end of one hour, nonprotein nitrogen 76 mg. per cent, serum calcium 12.2 mg. per cent, serum phosphorus 5.0 mg. per cent. Aspiration revealed milky white fluid in the cystic nodules.

Films of the thoracic and lumbar spine, pelvis and hips showed a large, smoothly outlined, lobulated, finely granular calcium deposit measuring 10 cm. in diameter just below the tuberosity of the left ischium. In addition, numerous smaller deposits lay in close proximity to the right ischial tuberosity, right greater trochanter and the sacral region. Other films showed the sternoclavicular area and the right shoulder to be similarly affected. There was uniform diffuse osteoporosis. The kidneys appeared normal in size and shape, but there were innumerable fine calculi in the calyceal regions of both kidneys and several larger ones in the left renal pelvis. There was only slight narrowing of the hip joints. The sacroiliac joints were wide and indistinct with increased density around them (Fig. 3). There was marked erosion of the inner end of the left clavicle.

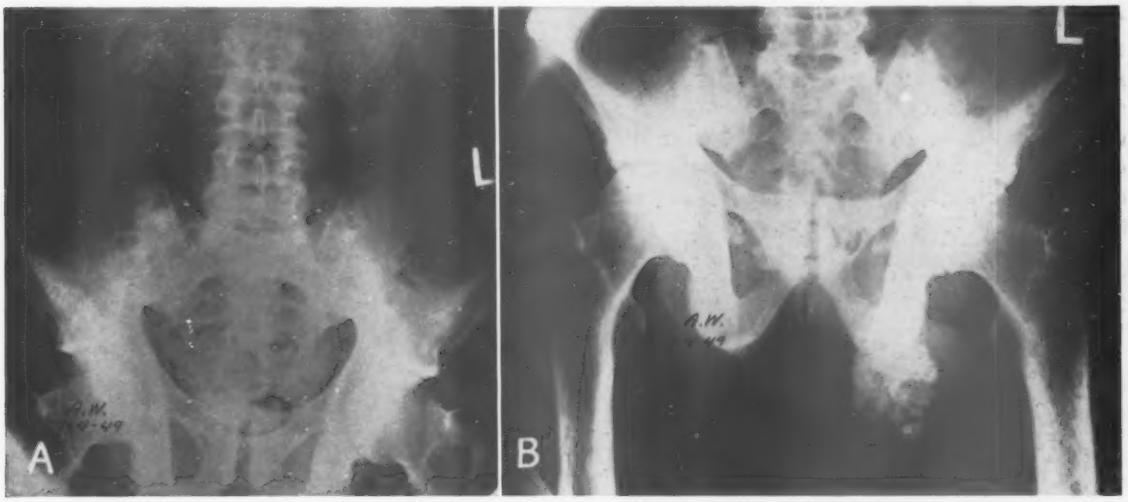

Fig. 3. Case II. Roentgenograms showing calcification in kidneys, prostate and near ischial tuberosity. (*A*) Roentgenogram of abdomen. (*B*) Roentgenogram of pelvis.

The vitamin D was immediately discontinued and the patient placed on a low calcium diet with added sodium citrate. The cystic mass over the sacrum was biopsied. It was described grossly as a bursa-like mass with white, fluid

* We are indebted to Dr. T. B. Bayles and The Robert Breck Brigham Hospital for permission to publish the details on patients in Cases II, IV, and V and to Dr. Leroy Parkins for the details on Case III.

contents and surrounded by a hard, white capsule. The pathologist characterized his sample as a semicystic, encapsulated mass with a glistening external surface and a multiloculated, necrotic interior. The cystic spaces were surrounded by fibrous tissue showing papillary projections coated with blue, granular material, presumably calcium. Other deposits of this same material were scattered throughout. In underlying tissues there were multinucleated, foreign body, giant cells, some of which contained granular, calcareous material.

The patient was discharged improved. Since that time he has been seen periodically over a period of one year. The serum calcium has fallen to 11.6 mg. and phosphorus to 4.5 mg., the nonprotein nitrogen to 53 mg. The phenolsulfonphthalein excretion has increased. Roentgenograms six months and one year after discharge have shown progressive decrease in the calcification of the kidneys and prostate and about the wrists. However, many small calculi still remained in both kidneys.

FIG. 4. Case III. Roentgenogram of left elbow showing periarticular calcification.

CASE III. M. L. This fifty-four year old housewife entered the hospital with a five year history of recurrent attacks of arthritis. During the two years immediately prior to admission her symptoms had been so severe that she was confined to bed. Her physician advised vitamin D (ertron) in dosage of 100,000 units per day. This was continued up until the time of admission. On this treatment she improved somewhat, but shortly relapsed and again returned to bed. Thereafter she gradually lost her strength and became so weak that she could not take care of herself. She developed multiple joint deformities, involving elbows, knees, hips and sternoclavicular joints. Intense itching caused her considerable discomfort.

Her laboratory studies at the time of admission showed a hemoglobin of 60 per cent and a fasting nonprotein nitrogen of 79 mg. per cent. Fluid removed from the elbow joint was the consistency and color of milk; its chemical analysis showed calcium 1,605 mg. per cent, phosphorus 675 mg. per cent, and uric acid 4.4 mg. per cent.

Films of the pelvis and hips at the time of admission showed marked destruction of the head and neck of the right femur. There was considerable erosion of the upper portion of the acetabulum, forming a cavity in which the remnant of the femoral head lay. A mass of calcific density filled out the rest of the acetabulum. There was also a faint, amorphous, calcium-containing shadow in the right gluteal region. It was smoothly outlined and lobulated. The pelvic bones and femora showed marked osteoporosis. No calcium was seen in the ischial bursae. The pelvic arteries showed considerable calcification. Films of the left knee showed, in addition to the usual findings of rheumatoid arthritis, a mass of calcific density anteriorly to and below the patella. There were smaller masses in the suprapatellar bursa and in the upper calf muscles. These muscles as well as those of the upper thigh showed long coarse streaks suggesting replacement of muscle fibers by fat. The popliteal artery was calcified. The elbows presented the most striking appearance, with large, lobulated masses of finely granular, calcific deposits around each elbow. The joints were almost obscured, but there was obviously marked destruction or absorption of the articular surfaces and underlying bones (Fig. 4). Although this patient is still alive, no follow-up roentgenograms have been obtained. She is completely bedridden. There has been continuous activity of the rheumatoid arthritis with progressive, disabling joint deformity. Pruritus, weakness, anorexia and nocturia, however, are her most prominent symptoms.

A massive, cystic swelling which discharges a thin, milky fluid is present over the left elbow.

There are three distinct, soft, fluctuant, egg-sized, subcutaneous masses present over the sternoclavicular articulations. A soft tumor which appeared on the dorsum of the right hand after discharge from the hospital has now disappeared.

On the basis of these findings it is assumed that the patient has suffered severe renal damage and that her serum calcium remains elevated although no vitamin D is being taken. The hypercalcemia would explain the persistence of pruritus and the cystic, periarticular masses.

Case iv. M. McK. This fifty-nine year old housewife entered the hospital with a fifteen year story of pain in the knees and lower legs. Four years prior to admission she developed a swelling on the back of the right hand which was shortly followed by a similar lesion on the left. All her fingers became stiff and swollen. The patient had to have repeated taps for symptomatic relief of the swellings. In addition they broke down and drained spontaneously on several occasions.

Physical examination showed a pale, poorly nourished, white female. There were markedly swollen, fluctuant areas over the back of the left hand and the right little finger. Her feet showed hallux valgus with stiffness and diffuse thickening typical of rheumatoid arthritis. The nonprotein nitrogen was 32 mg. and the urine showed one plus albumin.

The swelling on the left hand yielded 40 cc. of thick creamy material on aspiration. That on the right, about the size of an English walnut contained 10 cc. in which there were small bits of caseous, calcareous material. After aspiration this lesion was biopsied. The pathologist reported confluent areas of necrosis containing a peculiar admixture of debris, mainly granular amorphous material within which there were short strands of fibrinous material and small homogeneous dense bodies which stained like calcium. The necrotic zone was surrounded by a uniform band of hyalinized collagen bundles. Fibroblasts, eosinophilic giant cells and hemosiderin were present.

No diagnosis other than rheumatoid arthritis was made on this admission.

Roentgenograms taken at another hospital shortly prior to admission showed large areas of calcium deposition around several metacarpophalangeal joints, particularly the thumb, index, and fifth fingers on the right. There were similar areas of smoothly outlined, lobulated calcium deposits lateral to the right wrist and around the interphalangeal joint of the fifth finger on the left. There was marked resorption of the proximal phalanx of the left thumb and a large mass of calcium in this markedly swollen digit. The feet showed similar, but less marked changes. The knees were essentially normal. The kidneys appeared small. There were no urinary calculi visible.

On re-admission nine months later, it was discovered that the patient had taken 300,000 units of vitamin D (gelatabs) per day for a period of three years, therapy having been discontinued approximately four months before her initial hospital admission. On the second admission thirteen months after discontinuance of vitamin D, the fluctuant swellings were considerably smaller and the patient stated that her hands had progressively improved. Serum calcium and phosphorus were 9.9 and 4.4 mg. per cent respectively, nonprotein nitrogen 42 mg., phenolsulfonphthalein excretion 18 per cent at the end of one hour.

Roentgen examination showed considerable decrease in the soft tissue calcium deposits and definite recalcification of the bones. In several of the bones calcium deposits had occurred inside the medullary cavity.

When restudied eighteen months later, the tumor nodules on the hands had almost completely disappeared on physical examination. Roentgenograms confirmed this and demonstrated increasing density of the normal bones.

Case v. A. R. This patient was a forty-eight year old, unmarried school teacher, who developed back and shoulder pain eighteen months before her first hospital admission. The pains gradually involved both arms and became so severe that she was forced to give up teaching. Her knees had also become affected and progressed to such an extent that she was essentially bedridden. At the time of admission she had been taking ertron (50,000 units a day) for over a year.

Physical examination showed a well developed but emaciated female with thickening of the proximal interphalangeal joints and an 80° flexion deformity of the knees. Her nonprotein nitrogen was 37 mg.; maximum value on urine concentration test 1.014, and phenolsulfonphthalein excretion at the end of one hour 8 per cent. Both the serum calcium and phosphorus were elevated, being 11.1 and 6.5

mg. per cent as compared with normals of 9.4 and 4.0 mg.

Roentgen examination of the lumbar spine, pelvis and hips showed good bone detail and calcium content except in the femora where there was osteoporosis. The hip joints were normal. The kidneys were normal in size and shape and without calculi or calcification. The knees showed advanced rheumatoid arthritis with marked rarefaction of the ends of the bones, but no unusual calcium deposits. The hands and wrists showed advanced rheumatoid involvement, chiefly of the smaller joints and more marked on the left. No abnormal calcium deposits were visible.

At the end of two months after discontinuing vitamin D, the serum calcium and phosphorus values were 9.9 and 2.6 mg. per cent.

She was discharged at the end of five months.

When seen again six months later the patient's phenolsulfonphthalein was 50 per cent at the end of one hour, and the film showed no change in the lumbar spine, pelvis or hips.

Re-examination of the knees one year after the original admission showed marked recalcification of the bones. The knee joints themselves were still narrowed. There were no abnormal calcium deposits.

DISCUSSION

The roentgenological findings during the active stage of hypervitaminosis D, as illustrated by the cases presented as well as by others, may be summarized as follows: (a) generalized osteoporosis; (b) metastatic calcification.

The validity of attributing these findings to hypervitaminosis D is supported by experiments on animals and also by their reversal, the drop of serum calcium and phosphorus levels and the improvement of renal function after withdrawal of excessive doses of the vitamin in these cases. Whereas it has been repeatedly demonstrated that the metastatic calcification produced by excessive dosage of vitamin D may involve almost any of the soft tissue structures of the body, in this paper we have stressed its occurrence in the synovial cavities, bursae, tendon sheaths and other periarticular structures, and the concomitant occurrence of generalized osteoporosis. These findings are believed to be of diagnostic significance. However, one can by no means conclude that they constitute specific diagnostic criteria. Generalized osteoporosis is a very common finding and may occur in a wide variety of pathological states. Likewise, metastatic calcification may occur in many diseases. Moreover, in certain situations it may be of little pathological importance. It is the combination of these two findings which is significant. However, since metastatic calcification is such a striking roentgenological manifestation, it might be well to consider some of its more common causes. As has been stressed in the literature, any disease process which leads to an elevation of serum calcium and/or phosphorus of such magnitude as to exceed the solubility of these ions may be followed by metastatic calcification. Excellent reviews of this subject are available.[6,7,11,63,64] Among the causes which have been listed are: myelogenous leukemia, widespread sarcoma, osteomyelitis, multiple myeloma, Albers-Schönberg's disease, hyperparathyroidism, nephritis, and excessive intake of the combination of alkali and calcium.[5,50,63,64] The kidneys, gastric mucosa, lungs and heart have been stressed as the sites of predilection for the deposition of calcium. The periarticular areas are seldom involved. The appearance of the locally destructive osseous lesions in the malignant diseases and osteomyelitis are so characteristic that they should be readily recognized. Albers-Schönberg's disease (osteopetrosis) and osteopoikilia could hardly cause difficulty. We are left, therefore, with chronic nephritis, hyperparathyroidism and excessive calcium and alkali intake as differential possibilities, i.e., insofar as generalized metastatic calcification is concerned.[11,13,50] However, purely local causes may lead to calcification without changes in serum calcium and phosphorus values. Among the conditions which might be considered under this heading are calcinosis circumscripta, so-called "calcium gout" and tumor calcinosis[33,59] Because of the specific localization and

limited distribution of calcium deposits in the first two conditions mentioned, they hardly need be considered. Tumoral calcinoses, however, might be added to the above differential possibilities.

As far as we have been able to determine, the only disease processes in which such periarticular calcifications as we have described have been simulated are chronic nephritis, hyperparathyroidism and tumoral calcinosis.[13,33,50,59,63] In some instances the calcification has been indistinguishable from that in the cases presented.* Differentiation requires additional information. Tumoral calcinosis, though so rare as to be a medical curiosity, produces periarticular masses of calcium density. The masses, however, are solid, have a higher calcium content than found in the cases presented and are not accompanied by osteoporosis except in the area of involvement. The serum calcium and phosphorus values are normal. The "calcium-alkali" syndrome is not characterized by osteoporosis. Chronic nephritis and hyperparathyroidism present the most difficult differential problems. A decision may be impossible in the absence of history and laboratory data.

While periarticular calcification is an extremely rare complication of nephritis, this finding logically leads to the question as to whether the basic problem is not the renal disease so obviously present in each case rather than excessive vitamin D intake. The histories and findings readily disprove this contention. It has been clearly shown that excessive doses of vitamin D will cause renal damage. In some of the cases presented there is a definite history of normal renal function prior to vitamin D ingestion. In all instances there has been improvement in renal function after withdrawal of the drug. Moreover, withdrawal has been followed by a decrease in metastatic calcification in every instance in which follow-up was possible.

The cases presented are of interest not only roentgenologically, but also from the standpoint of pathological physiology. They provide an excellent opportunity to correlate the physiological activity of vitamin D and the pathologic sequelae which may result from its misuse. The *in vivo* effects of vitamin D have been extensively studied, mainly with irradiated ergosterol derivatives. The results of both large and small doses are well known and present an interesting paradox in behavior. Studies dealing with both humans and animals have demonstrated that, under normal circumstances, small doses of vitamin D cause no effect or perhaps a slight positive calcium or phosphorus balance.[8] In various deficiency states and with higher doses in normal animals, a definite calcium and phosphorus retention occurs and the density of the bone increases.[10] With further increase in dosage a definitely pathological picture supervenes. Marked hypercalcemia and hyperphosphatemia develop. These are accompanied by a negative calcium and phosphorus balance due to excessive urinary excretion of these elements.[4] The high levels of serum calcium and phosphorus may occur in the absence of any intake of these elements if the dosage of vitamin D is high enough.[47] Obviously under such conditions excretion must occur at the expense of the skeletal system.[26,30,34,37,62] Nevertheless, even while such resorption is occurring, metastatic calcification may be taking place. Because of the high levels of serum calcium and phosphorus their solubility in serum is exceeded and, as a consequence, precipitation of bone salts occur.[22] The hypervitaminosis is thus characterized by decrease in bone density, abnormal deposition of bone salts, and excessive excretion of calcium and phosphorus. The exact reasons for zones of predilection in metastatic calcification are poorly understood. The local factors affecting this are unknown. Low carbon dioxide value, high phosphorus concentration or previous tissue damage

* Since presentation of this paper, a patient with severe chronic nephritis showing identical periarticular calcification has been seen at the Peter Bent Brigham Hospital; and a sixth case of vitamin D_2 intoxication, with a combination of generalized skeletal demineralization and multiple small bilateral renal calculi, but no metastatic calcification has been seen.

have been suggested as possible explanations.[12,63] It is apparent that synovial cavities and bursae were sites of predilection in the present cases.

Experimental studies have also demonstrated that withdrawal of the vitamin is followed by reversion to normal serum values and metabolic balance of calcium and phosphorus. Recalcification of bone and resorption of metastatic deposits would be expected to occur. This has been found to be the case.[53] The physiological findings, therefore, have been reproduced in the cases presented.

The over-all picture of hypervitaminosis D is hardly this simple, however. It is apparent that many persons have used vitamin D in widely varying amounts. Some have developed toxic symptoms on low dosage while others have taken large amounts without apparent difficulty. The number of factors which may effect the potency of a given dosage of vitamin D are surprisingly high. Wolf[67] has compiled a list of these. It includes:

1. Duration of administration
2. Calcium and phosphorus intake.
3. Vitamin A content of diet
4. Age of patient
5. Activity of patient
6. Vehicle for administration
7. Route of administration
8. State of alimentary tract
9. State of endocrine system
10. Kidney function
11. Presence of rickets
12. Source of vitamin D

To these may be added the state of the skeletal system, environmental temperature, the intake of fat, the intake of mineral oil and the presence of bile.[44]

If the efficacy of any given dose schedule can be affected by so many factors, it is not surprising that the variation in individual susceptibility is so great. A fortuitous combination of the above factors may render any given patient especially vulnerable or markedly resistant. Moreover, it is possible that certain of these factors may influence specific localization of metastatic calcification.

Of the many factors listed one appears to merit special comment, namely, the source of the vitamin D. Fundamental to this consideration, however, is the realization that there are several vitamins D, all closely related chemically and each having definite antirachitic activity. The most important are D_2 and D_3. Vitamin D_3 is essentially a synthetic product. Each is designated by referral to the respective precursor from which it may be derived by a process of irradiation or other physically induced chemical transformation. The respective precursors of D_2 and D_3 are ergosterol and 7 dehydrocholesterol. The final antirachitic substances obtained by activation of these precursors are entirely different chemicals.

With these facts in mind it is of interest to examine carefully the reported cases of hypervitaminosis D. With unusually few exceptions they have occurred as a result of treatment with the vitamin obtained by irradiation or electrical activation of ergosterol, namely D_2.[66] The few reported cases of D_3 toxicity have all occurred in infants.[28,38,57] The possibility of other primary disease must be considered in each case.[67] A major part of this observed incidence is obviously due to the fact that vitamin D_2 is available in very high concentration and, up to the present time, has been the one commonly used for obtaining high dosage. Further investigation, however, has revealed some facts of singular interest in this situation.

Studies of toxicity have been confused because of the use of preparations containing compounds resulting from excessive irradiation of the potent product.[48,67] This consideration is probably of no importance in presently occurring cases of hypervitaminosis D. Metastatic calcification has been shown to occur after administration of pure, crystalline vitamin D_2.[53] The usual toxic effects of this vitamin appear to be related only to the antirachitic potency of the preparations used. However, physio-

logical studies do suggest definite differences in the potency and toxicity of the vitamins D_2 and D_3. Vitamin D_2 has essentially no effect in preventing or curing rickets in the chick while vitamin D_3 is extremely effective in low concentration.[9] Vitamin D_3 is three times more effective than D_2 as an antirachitic in human beings if the rat unit is used as a standard of reference.[44] Moreover, if doses in the toxic range are administered to rats, D_2, on a unit basis, is much more damaging than D_3.[27,40] Toxic effects, i.e., osteoporosis and metastatic calcification, occur with both vitamins. However, when equal amounts are given, the effects of D_2 are much more pronounced than those of D_3. The calcification produced by 50,000 units of irradiated ergosterol, D_2, is much more severe than that following administration of 80,000 units of tuna liver oil (D_3).

No similar studies on human beings are available. It is barely possible that the effects may not be comparable. Certainly further investigation is warranted as well as therapeutic trial of D_3 in place of D_2. The evidence is also sufficiently suggestive to merit abandonment of the commonly used terms, hypervitaminosis D and vitamin D intoxication, and substitution of a more accurate designation indicating the exact chemical involved.

CONCLUSIONS

1. Ingestion of excessive amounts of vitamin D_2 (irradiated ergosterol) may lead to the development of a roentgenological picture characterized by concomitant occurrence of generalized osteoporosis and metastatic calcification.

2. Abnormal calcium deposits may occur in almost any organ and tissue; however, under certain circumstances they may appear as large, smoothly lobulated, amorphous, cystic masses of calcium density restricted to periarticular structures, namely bursae, synovial cavities and tendon sheaths.

3. Metastatic calcification occurring in the absence of destructive bone lesions but in the presence of generalized osteoporosis should suggest the possibility of hypervitaminosis D_2.

4. In instances where the above criteria are met and metastatic calcification occurs in amorphous, smoothly lobulated masses confined to periarticular structures the differential posssibilities are almost completely limited to chronic nephritis, hyperparathyroidism and hypervitaminosis D_2.

5. The pathological physiology of hypervitaminosis D, as proved by animal experimentation, is very closely duplicated by the findings in the cases presented.

6. It is suggested that more attention be directed toward the possible specificity of vitamin D_2 in producing the clinical syndrome of hypervitaminosis D.

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DISCUSSION OF PAPERS BY DR. CAFFEY, AND DRS. CHRISTENSEN, LIEBMAN AND SOSMAN

Dr. E. B. D. Neuhauser, Boston, Mass. Until fifteen minutes ago I was not aware that I was to be asked to discuss these papers, so, unfortunately I can't refer to any obscure journals, although I would like to.

I think, as usual, Dr. Caffey has presented his subject so clearly that it leaves very little for the discusser to do except congratulate him. There are many things in the paper of interest, but as I have only made the diagnosis once and as the diagnosis in that instance was incorrect my experience is very limited.

It is interesting to attempt to correlate the experimental work of Dr. S. Burt Wolbach with the findings which Dr. Caffey has so ably described. In experimental animals, according to Dr. Wolbach, excessive vitamin A produces an increase in the rate of enchondral bone formation, although eventually premature closure of the epiphyses, thinning of the bones and overtubulation. On none of the sections that I have seen is there any evidence of gross subperiosteal new bone formation.

Naturally, the response in humans may be entirely different from that observed in laboratory animals, but it is possible that the amount of vitamin A administered or the rate of its administration may have much to do with the varying picture that one can find. Perhaps in a chronic vitamin A poisoning in humans one might expect to see changes similar to those described by Dr. Wolbach. I have no idea whether this occurs in human beings, and certainly to date I am not aware that anyone has recognized it, but perhaps it ought to occur.

I think it was an excellent paper and all of us should be prepared to recognize the clinical and roentgen picture of hypervitaminosis A.

I should not be allowed to discuss Dr. Sosman's paper as I know so little about it, but it is an extremely interesting subject and certainly it leaves open a wide field of speculation. We do know some of the functions of vitamin D and it is supposed to have, as I remember it, two primary functions. One is that it increases calcium resorption from the intestine and second, and perhaps totally unrelated, it increases phosphorus excretion by the kidneys. In many of the patients presented by Dr. Sosman the first mechanism is probably the important one. The excessive vitamin D probably also increases calcium resorption from the bones, leading to a high blood calcium level, so that there is an imbalance of calcium and phosphorus ions in the blood stream. With an excessive number of phosphorus and calcium ions deposition of calcium phosphate is to be expected.

We also know that there is a tendency of the parathyroid to diminish phosphorus levels in the blood and to increase its excretion. So one would expect that as soon as there is a high phosphorus content of the blood there is going to be some element of hyperparathyroidism with a final result of a complex interplay of processes. One would also expect that eventually some renal damage will ensue leading to a vicious cycle of change.

DR. FELIX G. FLEISCHNER, Boston, Mass. We thought that an observation we were fortunate enough to make recently might have some interest in connection with this symposium, particularly the second paper. It concerns a man of forty-two years who suffered from crippling polyarthritis for more than twenty years. For the last eight or nine years, he was completely incapacitated and about for the same period of time he had been taking large amounts of vitamin D preparations. There were, besides, the more common ertron darthonal and dolcin. I don't have the details with me but the dosage was exceedingly high.

We found in this man extensive calcifications of the kidneys, marked decalcification of all bones, but no calcification of tissues in the periarticular regions. Two years ago, Walsh and Howard from Johns Hopkins reported on observations which they had made in a number of patients with calcification in the eyes. They found by slit lamp examination two types of calcification, the one in the limbus of the cornea and the other in the conjunctiva.

In our case, we thought we could see some abnormality in the orbits on the routine skull roentgenograms.

(Slide) This is a section from the postero-anterior skull film. Here we thought we could see some faint, circular calcification. On the basis of the findings of Walsh and Howard, we took tangential or so-called bone-free views of the eyeballs.

(Slide) Here you see the anterior segment of the eyeball and the upper and lower lids. You see this curvilinear area of calcification, and, with a little different tangential projection, another more flecky calcification. We found these changes in both eyes. Up to the present we did not have any chance to check more cases of hypercalcemia. Among Walsh and Howard's cases were some of hyperparathyroidism, vitamin D poisoning, and 2 cases of sarcoidosis. In all those instances there was hypercalcemia. Our patient, too, had hypercalcemia. I won't go into details about this observation. It will appear in the *New England Journal of Medicine* in the near future.* I just wanted to call your attention to this finding which apparently is easily established and of clinical significance in instances of ocular calcification of this type.

DR. JOHN CAFFEY, New York, N.Y. Poisoning due to vitamin D_2 in children has been encountered largely in the treatment of tuberculosis in Europe, and in the treatment of refractory rickets in the United States. Under these circumstances renal injury has been the principal toxic effect and renal failure the cause of death. Periarticular calcifications have not been described, so far as I know, in such children, who of course did not have rheumatoid arthritis. Renal calcification, and early and extensive calcification of such structures as the falx cerebri, have been observed by us and many others in infants and children who have received toxic doses of vitamin D_2.

The massive periarticular and articular calcifications, so well demonstrated here this afternoon, occurred in patients with rheumatoid arthritis who received large doses of vitamin D_2. Similar calcifications have not been found in non-rheumatoid patients who received similar large toxic doses of vitamin D_2. My

* This report has since appeared in the *New England Journal of Medicine*, 1949, *241*, 863–865: "Conjunctival and corneal calcifications in hypercalcemia; roentgenologic findings," by F. G. Fleischner and S. R. Shalek.

personal opinion is that the lesions in Dr. Sosman's patient represent calcification of the diseased articular tissues of rheumatoid arthritis after high vitamin D_2 dosage rather than a primary vitamin D_2 effect on healthy tissues. Would Dr. Sosman please tell us if he has ever encountered periarticular calcifications, due to high dosage vitamin D_2, in non-rheumatoid persons?

Dr. Neuhauser is rightly disturbed by the inability of Boston pediatricians to obtain histories of excessive vitamin A dosage from the mothers of some of the patients he examines roentgenographically.

Dr. Sosman (closing). Thank you very much, Dr. Neuhauser and Dr. Fleischner and Dr. Caffey. Dr. Neuhauser's explanation of the difference in the acute experiments that Dr. Wolbach made and our results may be the time factor, chronic poisoning in our cases, acute poisoning in his animals.

One other thing I forgot to stress is that if any of you care to treat a case of sarcoidosis such as I showed at the end of the slides with these large doses of vitamin D, it would be well to watch the patient's urine carefully. If albumin or cells or casts appear drop the dose to the point where they disappear. We have one other patient where it was tried and the renal reaction was so prompt and severe that this treatment had to be abandoned, so it is a dangerous therapy as so many of the modern therapeutic implements are.

The nephritis is not permanent. Four of the 5 cases had a marked improvement after vitamin D_2 was stopped. In the first case of prolonged administration the nephritis was permanent and the patient died of that disease.

Dr. Fleischner's contribution is particularly interesting. The common denominator there again is the hypercalcemia. This is also a good example of what often happens, and why we have meetings like this. Dr. Fleischner is fully three blocks away from the Peter Bent Brigham Hospital; yet he didn't know that I was working on this type of vitamin D_2 intoxication and I didn't know that he had made the interesting observations which he presented here.

I would again like to thank you for your interest and attention. I would like to compliment Dr. Caffey on presenting us with another clean-cut clinical syndrome which he has carefully differentiated from the original Caffey's disease. We may have to call that Caffey's disease No. 1 and this one Caffey's disease No. 2.

ROENTGENOGRAPHIC CHANGES AND URINARY FLUORIDE EXCRETION AMONG WORKMEN ENGAGED IN THE MANUFACTURE OF INORGANIC FLUORIDES*

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INTRODUCTION

AMONG the many publications that have appeared concerning the various aspects of fluorosis there are very few reports of disability in the human cases. In connection with the examination of Danish workmen, Roholm[7] reported 10 cases of fluorosis in which the mobility of the spine was moderately restricted and 4 cases in which the restriction was almost complete. One other case of almost complete immobilization of the spine was reported in connection with fluorosis; this latter case was observed in India by Shortt.[8] Disability observed in the vertebral column was believed by both of these investigators to have been the result of the deposition of fluorides in the osseous tissues.

In England two workmen showing osteosclerosis which was believed to be due to absorption of fluoride were described by Wilkie[9]; in neither this report nor in those of investigators in other countries was any evidence of disability presented.

Data so far available concerning residents of the United States do not reveal evidence of disability associated with changes in bones that have resulted from exposure to fluoride. Bishop[1] investigated the bones of a man engaged in the manufacture of superphosphate; Linsman and McMurray[5] described those of a man who had been exposed to excessive fluoride in drinking water; McGarvey and Ernstene[6] reported the case of a man who had handled sodium fluoride for some thirty years; Dean[4] reported on the roentgenographic examination of 114 people who had ingested abnormally large amounts of fluoride in their drinking water for fifteen years or longer. Although each of these observers found evidence of changes in the density of the bones of the individuals examined, none of them referred to the occurrence of disability in their cases.

The investigation described below includes data concerning (1) the fluoride concentrations found in samples of urine obtained from 23 workmen engaged in the manufacture of inorganic fluorides, and (2) the results of roentgenographic examination of 15 of these men.

METHODS

During the summer of 1944, arrangements were made to start the collection of samples of urine from selected workmen employed in two industrial plants (designated as Plant A and Plant B) which were engaged in the manufacture of inorganic fluorides. Since it was not possible to have the collection of urine supervised by medically trained personnel, a chemist was selected at each of the two plants and all of the requisite precautions for avoiding contamination of the urine during its collection were made clear to these men. Chemically clean glass containers were sealed within paper bags and shipped to each plant. Containers having a capacity of about 150 cc. were supplied for the collection of a preliminary set of spot samples of urine. For all other samples of urine one gallon jugs were provided, and the workmen were instructed to void into these containers (1) only during the hours away from their work, (2) only after removing all contaminated clothing and (3) only after having bathed. Since 2 to 3 liters of urine were desired in each sample, the period of collection covered several

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days. Inasmuch as the period of collection involved the voiding of urine on several occasions, the specimen probably was a fair representation of the average urinary fluoride excretion of the employee for each period of collection. The samples were resealed in paper bags and shipped to this laboratory for analysis of fluoride content.

Determination of the fluoride content of the urine involved: (1) ashing, with magnesium acetate used as a fixative; (2) removal of the fluoride from the ash by distillation, using the perchloric acid method; and (3) estimation of fluoride in the distillate by the thorium-nitrate back-titration procedure.

Early in 1946 roentgenograms were obtained of the head, chest, pelvis and extremities of some of the employees from whom samples of urine had been collected. Some of these same employees were again examined roentgenographically in 1947 and all of the films were reviewed by one of us (P.G.B.).

RESULTS

1. *Urinary Findings.* The fluoride concentrations found in samples of urine obtained from selected employees at Plant A are presented in Table I, and similar data obtained from employees at Plant B are recorded in Table II.

The 10 employees listed in the upper portion of Table I were engaged directly in the manufacture of inorganic fluorides. Samples of urine from Employees No. 8, 9, 13, 21, 23, and 27 were, for the most part, abnormally high in fluoride concentrations, but these concentrations probably do not exceed the normal level, 0.5 to 1.0 mg. per liter, to a significant extent. The much higher urinary fluoride concentrations observed in samples collected by Employees No. 10, 19, 25 and 28 were considerably above the normal range; 14 of the 23 sam-

TABLE I

THE FLUORIDE CONTENT, MILLIGRAMS PER LITER, OF SAMPLES OF URINE OBTAINED FROM MEN ENGAGED IN THE MANUFACTURE OF INORGANIC FLUORIDES IN PLANT A

Employee No.	Age	Length of Service Years	9/29/44*	5/15/45	4/9/46	8/12/46	1/21/47	2/18/47	7/16/47
8	54	19	4.56	6.0	5.28	—	—	—	—
9	38	15	4.08	4.63	3.68	3.80	—	—	—
13	40	17	2.80	1.72	1.88	2.66	2.60	—	—
21	30	7	1.96	3.22	2.80	1.72	5.08	4.96	—
23	61	21	1.16	4.16	1.72	2.20	1.32	—	—
27	60	15	2.96	3.88	1.32	1.48	2.80	—	0.96
10	55	10	12.68	8.37	9.00	—	12.30	—	8.08
25	46	17	4.86	6.28	28.40	10.92	10.60	—	12.68
19	54	14	8.08	15.36	12.60	7.70	11.08	8.88	—
28	57	25	24.00	22.40	16.20	13.72	9.28	12.68	—
6	27	7	1.56	4.08	2.20	2.38	1.28	2.20	—
11	68	14	1.16	1.84	—	—	—	—	—
14	42	22	1.23	1.06	0.75	—	0.48	—	0.72
15	34	19	1.60	4.01	0.78	2.39	2.20	2.68	0.80
4	31	10	2.00	1.22	0.90	2.44	1.68	—	—
1	49	9	0.88	0.79	—	—	—	—	—
30	39	11	0.84	0.64	0.72	0.52	0.48	0.60	0.58

* Spot samples of urine; all of the rest averaged 2 to 3 liters in volume.
Employees No. 10, 19, and 25 worked with HF; No. 28 with sodium bifluoride.
Employee No. 6 worked in yard; No. 11, general work; No. 14, garage; No. 15, shop.
Employee No. 4 worked in the laboratory.
Employees No. 1 and 30 worked in the office.

ples from these men were found to contain fluoride in excess of 10 mg. per liter. The importance attached to these data will be shown later in connection with the roentgenographic findings.

The results of analysis of samples of urine collected by Employees No. 6, 11, 14 and 15 (Table 1) show the slight and variable concentration of fluoride which appears in the urine of men who were exposed only intermittently to the conditions during the manufacturing processes. The range of the values was 0.48 to 4.08 mg. per liter. The analytical results observed in relation to samples of urine collected by an employee (No. 4) of the laboratory at Plant A fall in this range.

The fluoride content of samples of urine collected from Employees No. 1 and 30, who worked in the office, was less than 1 mg. per liter in all of the samples submitted. These values serve as control data, and suggest that outside factors, e.g. drinking water, played no part in producing the abnormally high urinary fluoride concentrations noted above.

At Plant B only one man, No. 2 in Table II, consistently showed extremely high concentrations of fluoride in samples of urine that he collected. All seven of the samples obtained from him showed concentrations that exceeded 10 mg. per liter. Employee No. 10 was equally consistent, in that all five samples obtained from him yielded relatively low fluoride concentrations, 0.6 to 1.3 mg. per liter. The remainder of the samples from employees at Plant B were quite variable in respect to fluoride concentrations, ranging from 2.00 to 17.20 mg. per liter.

Two employees of Plant B (No. 10 and 12) retired during the summer of 1946 and both of them collected samples of urine on two different occasions after that. The fluoride concentrations fell to normal limits in these samples and showed that at Plant B, just as was the case noted above in connection with Plant A, outside factors such as fluorides in the drinking water played no likely part in producing the abnormally high urinary fluoride concentrations.

TABLE II

THE FLUORIDE CONTENT, MILLIGRAMS PER LITER, OF SAMPLES OF URINE OBTAINED FROM MEN HANDLING A FLUORIDE-CONTAINING MINERAL IN PLANT B

Employee No.	Age	Length of Service Years	8/21/44*	6/26/45	2/15/46	5/29/46	8/9/46	10/30/46	3/27/47	5/19/47
2	42	6	16.30	23.90	13.30	18.90	11.30	8.10	—	6.08
10	68	12	1.30	0.60	—	1.10	—	0.40**	—	0.59**
11	43	26	17.20	6.40	8.90	7.90	3.30	6.60	4.68	3.48
12	72	14	2.80	4.70	4.70	2.00	—	0.90**	—	0.76**
13	30	11	13.20	6.70	4.80	2.90	4.60	4.30	4.56	4.28
14	32	6	7.80	4.60	13.90	5.20	8.90	4.30	4.68	2.68

* Spot samples; the rest of the samples averaged 2 to 3 liters in volume.
** Samples obtained after these men had retired.

2. *Roentgenographic Findings.* Roentgen changes were encountered in 5 of the 16 workmen examined. A brief description of these cases follows:

Employee No. 10—Plant A. There was slight increase in density of the lower thoracic spine with calcification extending into the attachments of the lateral ligaments (Fig. 1), together with some increased density in both ilia and in the sacrum (Fig. 2).

Employee No. 28—Plant A. There was marked increase in the density of the bones of the pelvis, the head and neck of the femurs (Fig. 3), the lumbar and dorsal spine and ribs (Fig. 4), the clavicles, scapulae, and the bones of the forearm. An osteophyte was observed on the medial surface of the middle third of the shaft of the right radius.

Employee No. 2—Plant B. The ribs and the lower thoracic and lumbar spine showed a

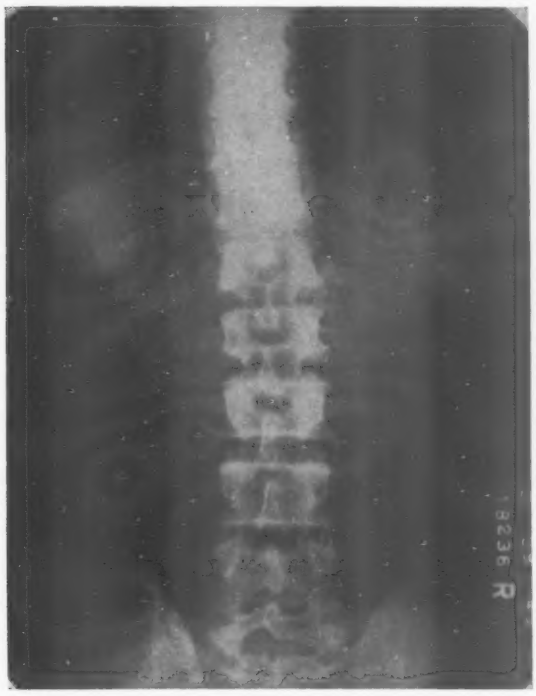

Fig. 1. Employee No. 10—Plant A.

moderate increase in density (Fig. 5). There was moderate increase in the density of the pelvic bones (Fig. 6), and a questionable increase in the density in the bones of the right forearm and left ankle.

Employee No. 12—Plant B. Except for marked hypertrophic lesions in the lumbar spine (Fig. 7 and 8), the films showed little abnormality. From our point of view these changes are probably without significance.

These 4 men were re-examined one year later and no further changes were observed.

Fig. 2. Employee No. 10—Plant A.

Fig. 3. Employee No. 28—Plant A.

Employee No. X—Plant B. There was a marked increase in the density of the bones of the pelvis, upper femurs and lumbar spine, and all other bones examined. Of particular interest is the fact that the sacrotuberous and sacrospinous ligaments showed marked ossification (Fig. 9). Although this patient was not living at the time when the present investigations were conducted, reference is made to the roentgenographic findings because of the classic appearance of the abnormally dense bones. It is highly probable that this increased density was the result of occupational exposure to fluorides.

Fig. 4. Employee No. 28—Plant A.

FIG. 5. Employee No. 2—Plant B.

This patient had worked at Plant B over a period of forty years, but had retired some seven years before the increased density in the bones had been discovered on a routine chest film made in 1937.

3. *Roentgenographic Findings in Relation to Urinary Fluoride Excretion.*

In 1946, 10 of the 17 employees of Plant A listed in Table 1 were examined roentgenographically. The density of the bones of Employees No. 9, 13, 21, 6, 15 and 4 appeared normal. The fluoride concentrations in samples of urine obtained from these particular men did not exceed 6 mg. per liter.

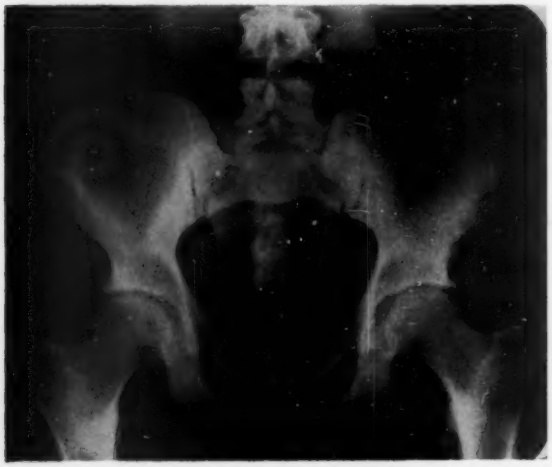

FIG. 6. Employee No. 2—Plant B.

FIG. 7. Employee No. 12—Plant B.

Increased density of the bones was observed in roentgenograms of Employees No. 10, 19, 25 and 28. The urinary fluoride concentration of samples of urine obtained from these men was consistently the highest of all samples submitted from Plant A. The highest average concentration of fluoride was found in samples obtained from Employee No. 28. The bones of this man showed more marked changes than did those of any other workman. Re-examination of Employee No. 28 in 1947 showed no change in the roentgenographic appearance.

FIG. 8. Employee No. 12—Plant B.

Roentgenographic examinations of the 6 employees in Plant B listed in Table II were made in 1946 and in 1947. Employee No. 2 was the only member of this group whose bones showed increased density. His were the only samples of urine that consistently contained excessively high concentrations of fluoride.

FIG. 9. Employee No. X—Plant B.

DISCUSSION

Among the subjects included in this investigation, a definite correlation appears to exist between the level of the fluoride concentration in the urine and the presence or absence of changes in the density of the bones. The data were obtained from too few individuals and during too short a period of time to warrant any sweeping generalization, but as a basis for discussion, the fluoride concentration of 10 mg. per liter may be taken as a level of fluoride excretion above which an associated increase in the density of bones may be expected to occur, and below which these changes might not be expected to occur. As indicated in Table III, the average concentration of fluoride in the urine of those who showed increased density in their bones was, with one exception, 10 mg. per liter or greater. Those whose urinary levels were below 10 mg. per liter had no demonstrable alteration of their bones.

There is no evidence of correlation between the length of service of workmen and the occurrence of the changes in bone density. Neither does there seem to be any correlation between these changes and the age of the workmen. Detailed clinical examination of the workmen of these plants could not be carried out and therefore no other data are available for consideration.

It is noteworthy that the roentgenograms which showed the most marked increase in bone density (Fig. 3, 4, 5, 6 and 9) revealed little or no evidence of hyper-

TABLE III

EXTENT OF THE INCREASES IN RADIOPACITY OF BONES SHOWN IN RELATION TO AVERAGE URINARY FLUORIDE EXCRETION OF EMPLOYEES AT PLANTS A AND B

Employee No.	Plant in Which Employed	Age	Length of Service Years	Average Urinary F Concentration mg. per liter	Extent of Increase in Density of Bones Seen in Roentgenograms
2	B	42	6	11.65	Marked
28	A	57	25	16.38	Marked
19	A	54	14	9.30	Slight
25	A	46	17	12.29	Slight
10	A	55	10	10.09	Slight
9	A	38	15	4.05	None
13	A	40	17	2.33	None
21	A	30	7	3.29	None
11	B	43	26	5.18	None
13	B	30	11	5.67	None
14	B	32	6	6.51	None
6	A	27	7	2.28	None
15	A	34	19	2.07	None
4	A	31	10	1.65	None
10	B	68	12	0.70	None
12	B	72	14	2.64	None

trophic changes in the vertebrae in the regions of increased density. These findings are at variance with the findings of the investigators[7,8] who claimed that deposition of fluoride in bones was the cause of hyperplastic changes in the spine. As a matter of fact the most marked hypertrophic spurring of the vertebrae was found in films which gave no significant evidence of increased bone density (Fig. 7 and 8). Chamberlain[3] reported huge osteophytes and complete bony ridges in the vertebral columns of stevedores examined in an investigation of the changes in bones associated with very hard labor. Since hard labor may produce hyperplastic changes in bones, what would be the result if fluorides were to be deposited in bones already changed by hard labor? Might the effect be one of making minor abnormalities more apparent because of increased radiopacity associated with the deposition of fluorides? One wonders if Roholm may not have overemphasized the part that fluorides may play in causing limitation of mobility of the spine.

Among the 22 cases of fluorosis reported in the American literature (6 reported here, 13 by Dean[4] and 1 each by Bishop[1], Linsman and McMurray[5], and McGarvey and Ernstene[6] none has been disabled. This also is in contrast with the reports of cases of fluorosis among Danish workmen.

Just why disability has not been recorded among American workmen remains unanswered. Analytical data show that the concentrations of fluoride in the bones of American workmen approached the levels reported by Danish investigators. The fluoride content of bone ash ranged from 0.3 to 0.7 per cent in a patient described by Bishop,[1] from 0.7 to 0.8 per cent in that of Linsman and McMurray[5] and from 0.8 to 1.0 per cent in the men investigated by Roholm.[7] Such being the case, one must seek some factor in addition to deposition of fluoride to account for the hyperplastic changes observed in the bones of some of the persons who have been reported to have chronic fluorosis.

SUMMARY

1. Samples of urine obtained from employees of two factories in which inorganic fluorides are manufactured contained fluoride in concentrations that ranged from normal levels of less than 1 mg. per liter to abnormal levels as high as 28 mg. per liter.

2. Five workmen out of sixteen who were examined roentgenologically showed increases in bony density. These men had excessively and consistently higher concentrations of fluoride in samples of their urine than did the employees whose bones were normal in density.

3. Among the workmen whose bones showed increased opacity to roentgen rays, only two were found in whom the bone changes were marked. Neither of these workmen was demonstrably disabled.

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SHORTENING OF THE POSTERIOR WALL OF THE SELLA TURCICA CAUSED BY DILATATION OF THE THIRD VENTRICLE OR CERTAIN SUPRASELLAR TUMORS*

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CHANGES in the roentgenographic appearance of the sella turcica often indicates the presence of intracranial disease. Such abnormalities are best understood when correlated with pathologic changes coexistent in the brain and its ventricles and the subarachnoid spaces. The present communication is concerned with shortening of the posterior wall of the sella turcica with or without sellar enlargement or atrophy. The role of the third ventricle in this process is of particular interest, especially regarding the configuration and position of its floor in relation to the sella turcica and the cisternae interpeduncularis and pontis.

Three possibilities for these changes are discussed. First, shortening of the posterior wall might be due to dilatation of the third ventricle; second, the floor of the third ventricle may in such instances protrude downward into the cisternae interpeduncularis and pontis indicating an additional pattern of herniation; and third, shortening of the dorsum sellae may occur in the absence of third ventricular enlargement.

MATERIAL

In order to arrive at a base line for estimating the size of the sella turcica and the position of the posterior clinoid processes in relation to the anterior clinoids, 150 consecutive negative skull roentgenograms were studied. The average length of the sella turcica was found to be 10.5 cm. and the average depth 8.4 cm. This corresponds with the measurements reported by Heublein[2] and those summarized from the literature by Orley.[3] It was found that the uppermost tips of the posterior clinoid processes were at about the same level as the tips of the anterior clinoids, but that in approximately 10 per cent of cases the tips of the posterior clinoids might be 1 or 2 mm. above or beneath the tips of the anterior clinoids.

The pathologic material upon which the present report is based consists of 15 cases of stenosis of the aqueduct of Sylvius, 9 of basilar arachnoiditis, 17 craniopharyngiomas, 30 pituitary adenomas, 18 tumors of the third ventricle, 7 pineal tumors, 10 suprasellar meningiomas and 7 aneurysms of the internal carotid artery. All were verified either at operation or necropsy with the exception of 5 of the cases of stenosis of the aqueduct of Sylvius. In the latter 5 cases exploration of the posterior fossa had been negative, and the roentgen appearance of the ventricular system and sylvian aqueduct were quite characteristic.

As controls, the pneumoencephalograms of 35 verified frontal lobe tumors, 55 verified parietal lobe, temporal lobe and temporoparietal lobe tumors and 10 verified intraventricular tumors of the lateral ventricles and corpus callosum were reviewed for the appearance of the third ventricle and sella turcica. Similar observations were made on 35 verified cerebellar tumors. No differentiation was made for the various histopathologic types in the control series.

OBSERVATIONS

Aqueduct Stenosis—15 cases. Atrophy of the sella turcica was seen on plain film examination in 11 patients. Of these 9 had an advanced degree of atrophy and 2 were moderately atrophied. The remaining 4 had slight but definite atrophy of the sella. Separation of the cranial

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FIG. 1. C.V., male, aged thirteen. Aqueduct stenosis. Ventriculogram showing pronounced dilatation of the lateral ventricles. The floor of the third ventricle is draped over the shortened posterior wall of the sella turcica. The sella is enlarged and moderately atrophied.

sutures was noted in the 6 with slight or moderate sellar atrophy, while in the remaining 9 the suture lines were intact. All 15 had shortening of the posterior wall of the sella turcica varying from 0.4 cm. to 1.3 cm. The usual bulbous tips of the posterior clinoids were absent, while the remaining stump presented varying degrees of atrophy. The degree of atrophy was more pronounced in those patients with intact cranial sutures, while less atrophy was noted in the sellas of the patients with spread sutures. Apparently the opening of the suture lines relieved the increased intracranial pressure sufficiently to take some of the pressure off the sella turcica.

Enlargement of the sella was present in 13 cases. In 2 cases, both with diastases of the cranial sutures, the measurements of the sella were within average limits. The largest sella measured 1.9 cm. in length and 2.4 cm. in depth. In this instance the posterior clinoids were shortened by 1.3 cm.

The lateral cerebral ventricles were markedly dilated in each instance, and no displacement from the midline was present. In 9 cases the third ventricle was well visualized, and in each the chamber was markedly dilated, assuming an ovoid or polygonal configuration as seen in the frontal projections. In the lateral views the anteroinferior aspect of the third ventricle protruded towards or into the sella turcica. The infundibular and chiasmatic recesses were smoothed out by the dilatation of that chamber. Just caudad to this region the sagging floor of the third ventricle could be seen draped over the shortened posterior clinoid processes, so that it appeared to be supported as if by a crutch. Further caudad, the third ventricle floor dipped towards the cisterna interpeduncularis, and in 3 instances the downward extension was sufficient to intrude into the superior aspect of the cisterna pontis (Fig. 1).

Basilar Arachnoiditis—9 cases. The sella turcica was markedly enlarged in 4, moderately enlarged in 2 and approximately normal in size in 3 patients. The largest sella measured 1.6 cm. in length and 1.9 cm. in depth and, like the other cases with sellar enlargement, was atrophied. Shortening of the posterior clinoid processes occurred in each case, varying from 0.1 to 0.9 cm., 7 of which were from 0.4 to 0.9 cm. In the 3 cases in which the sella was approximately normal in size the suture lines were open.

Pneumoencephalograms were available in

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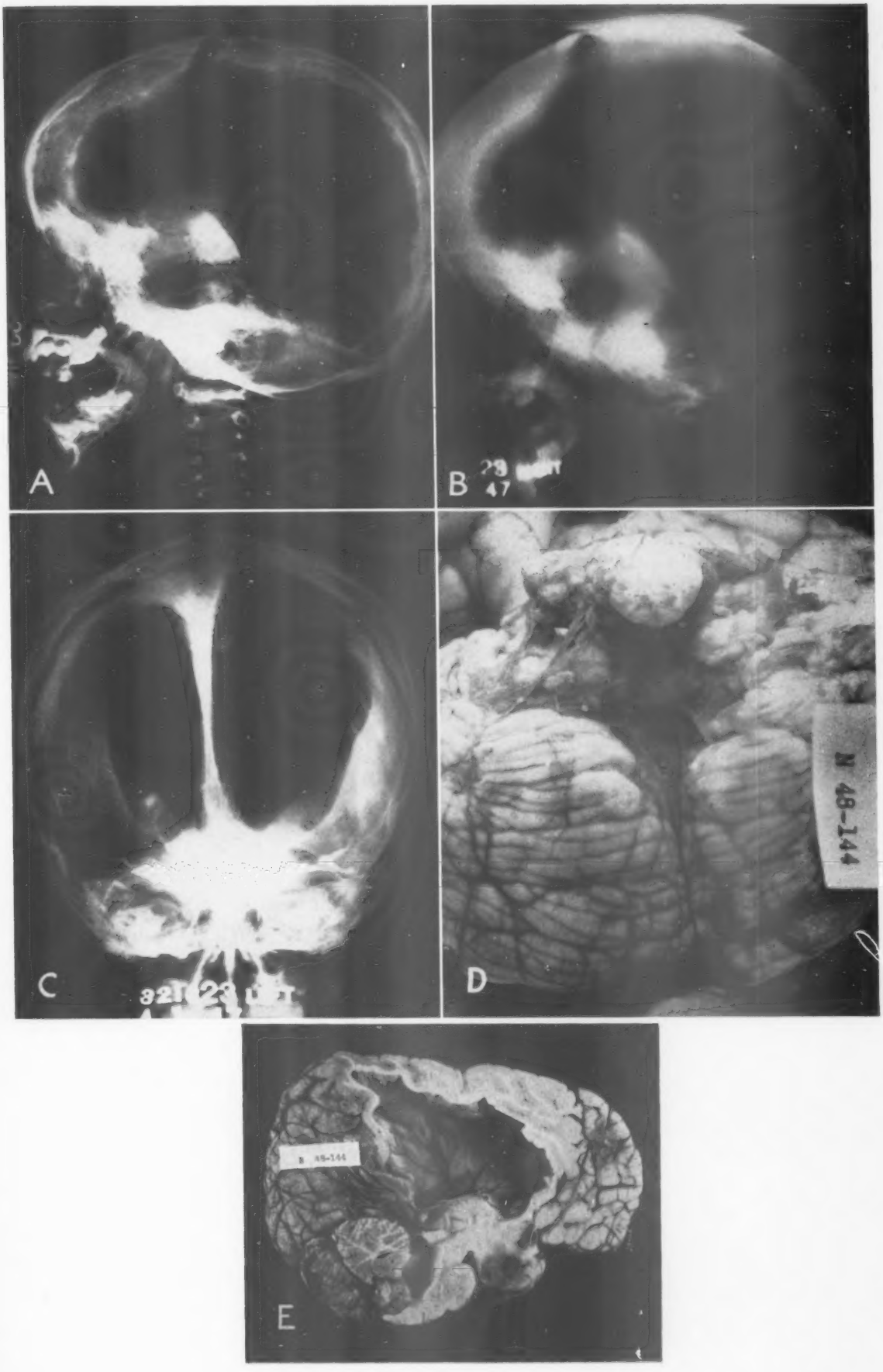
FIG. 2. E.F., male, aged four. Basilar arachnoiditis. (*A*) Lateral pneumoencephalogram showing pronounced ventricular dilatation. The third and fourth ventricles are rather poorly seen because of the overlying mastoid densities and the shadows of the dilated temporal horns. The coronal suture line is open. (*B*) Midline laminagram clearly demonstrating the dilated third and fourth ventricles and the shortened and dilated aqueduct of Sylvius. The floor of the third ventricle is draped over the shortened posterior wall of the sella turcica, and fills the cisterna interpeduncularis and enters the cisterna pontis. (*C*) Anteroposterior ventriculogram showing pronounced ventricular dilatation. The third ventricle is polygonal in configuration. (*D*) The basilar arachnoid filmy adhesions as seen with the cerebellum retracted. (*E*) Sagittal section of the brain. The dilated ventricular system is evident. The downward protrusion of the floor of the third ventricle reaches the upper level of the pons.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each case. The lateral ventricles were markedly dilated and in the midline in all. The third ventricle was well seen in the frontal projections in each and all were markedly dilated, presenting an ovoid or polygonal configuration. In the lateral views the third and fourth ventricles and the aqueduct of Sylvius were seen in 8 cases. The anteroinferior aspect of the third ventricle with obliterated chiasmal and infundibular recesses protruded towards or into the cavity of the sella in each instance. In 6 cases there was draping of the floor of the third ventricle across the shortened posterior clinoid processes, with the floor of the sella turcica bulging down into the cisterna interpeduncularis. In 3 of these the degree of downward extension was sufficient for the floor of the third ventricle to reach the superior aspect of the cisterna pontis.

The cerebral aqueduct was shortened and dilated in each case. The fourth ventricle was also markedly dilated, the fastigium to floor measurements averaging 3.5 cm. and the distance between the superior and inferior angles averaging 5.7 cm. (Fig. 2).

Craniopharyngiomas—16 cases. The sella turcica was markedly enlarged in 4, moderately enlarged in 4 and approximately normal in size in 8 cases. The largest sella measured 3.0 cm. in length and 2.4 cm. in depth. Interestingly enough, in this patient, who had an intrasellar craniopharyngioma, the bony density was fairly well maintained, and the roentgenograms had been interpreted preoperatively as a chromophobe pituitary adenoma. Marked atrophy of the sella was encountered in 4 patients, moderate atrophy occurred in 5 and in the others slight or no sellar atrophy was present. Calcific deposits in the vicinity of the sella of a flocculent or spotty nature was present in 14 cases, and in these the diagnosis of craniopharyngioma was evident on the plain films. Shortening of the posterior clinoid processes varying from 0.2 to 0.5 cm. occurred in 8 patients. This shortening was equally frequent in patients with or without enlargement or atrophy of the sella turcica. Spreading of the suture lines occurred in 6 patients, and in these the bony density of the sella was relatively better maintained.

Pneumoencephalographic examinations were available in 12 cases. Enlargement of the lateral ventricles occurred in 10, and in 2 the degree of dilatation of these chambers was minimal. The third ventricle was filled with gas in 8 patients. In none of these did the floor of the third ventricle approach the level of the sella turcica. In each there was a filling defect in the anteroinferior aspect of the third ventricle, and in 6 of these the tumor was sufficiently large to reach the foramen of Monro.

The shortening of the posterior clinoids and the enlargement of the sella turcica was believed to be due to the presence of the craniopharyngioma extending into and above the sella and resting on the posterior clinoid processes. The increased intracranial pressure was caused by the impingement of the tumor on the foramen of Monro. This, therefore, represents an instance in which atrophy of the sella and shortening of its posterior clinoid processes are related to the presence of a tumor mass rather than to enlargement of the third ventricle (Fig. 3).

Pituitary Adenomas—32 cases. The sella turcica was markedly enlarged in 28 and moderately enlarged in the remaining 4 cases. The largest sella measured 3.1 cm. in length and 3.0 cm. in depth. Almost all of these cases presented roentgenographic evidence of an intrasellar tumor which was quite characteristic, and the degree of atrophy and posterior inclination of the dorsum sellae was frequently pronounced. In 4 patients shortening of the posterior wall of the sella of from 0.3 to 0.5 cm. was noted.

Pneumoencephalograms were available in 8 patients. Three of these were patients with shortening of the dorsum sellae, and in these the shortening was seen to be due to impingement of an extrasellar protrusion of the pituitary adenoma on the posterior clinoid processes.

Hydrocephalus was present in 2 cases, and the third ventricle was seen in 5. The anteroinferior aspect of the third ventricle was displaced away from the sella by the tumor. The extrasellar extensions were visualized by the enveloping gas in the basilar cisterns.

Third Ventricle Tumors—15 cases. On reviewing a series of 15 cases of tumors of the third ventricle, 10 of whom had colloid cysts, there was but 1 who showed slight shortening of the posterior wall of the sella. Pronounced atrophy of the sella turcica was present in each case, together with slight or moderate enlargement of the sella.

Suprasella Meningiomas and Meningiomas of the Tuberculum Sellae—10 cases. Atrophy and

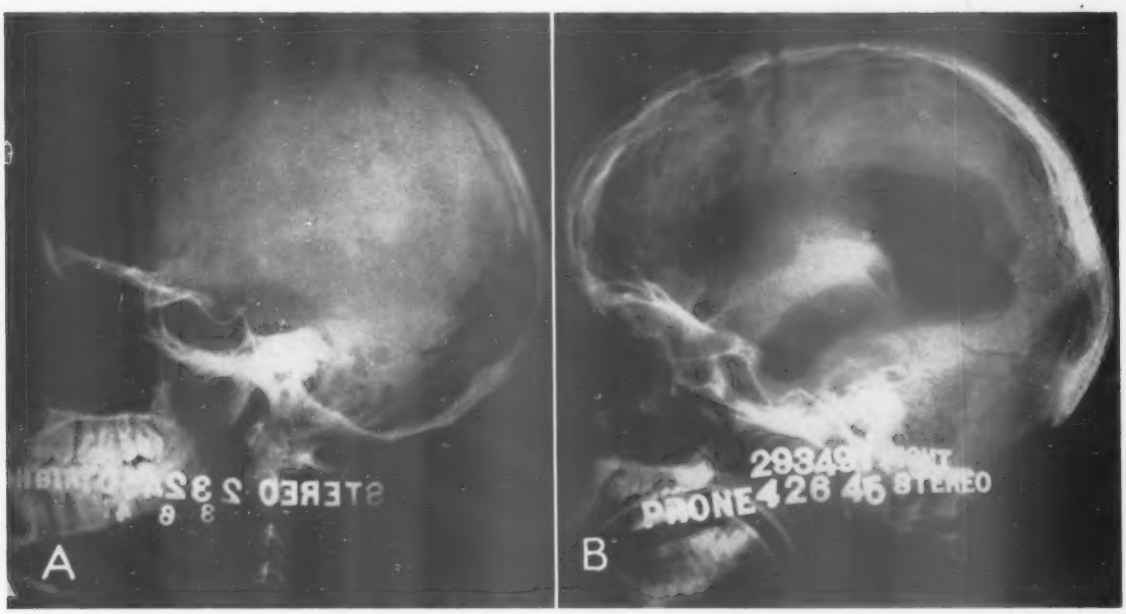

Fig. 3. (*A*) M.D., female, aged twelve. The posterior wall of the sella turcica is shortened by 3 mm. The usually bulbous, rounded tips of the posterior clinoids are flattened. Calcification is present in the craniopharyngioma. No increase in intracranial pressure can be seen roentgenologically. (*B*) S.L., male, aged eight. The posterior wall of the sella turcica is shortened. The tumor mass can be seen impinging against the third ventricle, elevating this chamber. Craniopharyngioma.

enlargement of the sella turcica was seen in 2 cases, and slight shortening of the posterior wall of the sella was seen in 1 case. In this case the tumor was outlined by gas in the basilar cisterns and could be seen impinging on the posterior clinoid processes. In the remaining 7 cases the tumor as seen on the pneumoencephalograms did not approach the posterior clinoids.

Pineal Tumors—7 cases. Atrophy of the sella turcica was seen in 6 cases, and enlargement of the sella was present in 4. In the latter 4, the degree of atrophy was pronounced, and the dorsum sellae was almost completely gone. Pneumoencephalograms were available in all. The lateral ventricles were markedly dilated and in the midline in each case. The third ventricle showed a characteristic filling defect in the posterosuperior aspect of the chamber, while the anterior portion was markedly dilated with extension of the anteroinferior angle towards or actually into the sella. In 3 cases there was slight draping of the floor of the third ventricle over the shortened posterior clinoid processes (Fig. 4).

Fig. 4. R.C., male, aged forty-nine. Extrasellar protrusion of pituitary adenoma. The posterior wall of the sella turcica is slightly shortened. The sella turcica retains its normal shape and bony density. The adenoma can be seen impinging against the anteroinferior aspect of the third ventricle, resting on the posterior clinoid processes. Verified at operation.

Aneurysms of the Internal Carotid Artery—7 cases. In 1 case there was slight shortening of the posterior wall of the sella turcica, and pneumoencephalograms in this patient showed the aneurysm impinging against the posterior clinoid processes. The sella turcica in the other cases were normal.

Frontal Lobe Tumors—35 cases. Shortening of the posterior wall of the sella from 3 to 5 mm. occurred in 2 cases. In neither was the sella increased in size although marked atrophy was present in both. The third ventricle was outlined by gas in both, and in neither did it approach the sella turcica.

Parietal, Temporal and Temporoparietal Tumors—55 cases. Shortening of the posterior wall of from 3 to 5 mm. occurred in 2 cases. Both had pronounced sellar atrophy without enlargement, and in neither did the third ventricle reach the sella turcica.

Lateral Ventricle Intraventricular Tumors—10 cases. Shortening of the posterior wall of the sella turcica did not occur in any of these patients.

Posterior Fossa Tumors—35 cases. Shortening of the posterior clinoids from 3 to 6 mm. occurred in 3 patients. All of these were children with marked dilatation of the lateral and third ventricles. The third ventricle could be seen in close proximity to the posterior clinoids in each.

DISCUSSION

The data reported here indicate that shortening of the posterior wall of the sella turcica may occur with or without enlargement and atrophy of the sella. Its incidence in patients without sellar enlargement appears to be limited to those in whom a suprasellar or parasellar mass impinges upon the posterior clinoids. Good examples of this are seen in the craniopharyngioma group in which several instances of shortening of the posterior wall occurred together with a relatively normal sized sella of good bony density. Extrasellar extension of pituitary adenomas may likewise cause such a change. Pneumoencephalograms in these cases showed no dilatation of the ventricular system, the reason for this being that the tumor was not large enough to reach the foramen of Monro. The appearance of the third ventricle in these cases indicated that this structure played no part in the shortening of the posterior sellar wall.

A second and more frequent mechanism involves dilatation of the third ventricle. Twining[5] has shown that sellar enlargement occurs when the anteroinferior aspect of the third ventricle dilates and projects towards the concavity of the sella, and his view has been widely accepted. Such dilatations may occur in a wide variety of intracranial conditions. Lesions in the posterior fossa and along the sylvian aqueduct are the most frequent causes, while tumors of the posterior aspect of the third ventricle may also cause pronounced hydrocephalus by blocking the aditus of the aqueduct of Sylvius. As shown by the data reported here, the most marked degree of third ventricular dilatation occurs in patients with aqueduct stenosis and with basilar arachnoiditis.

An unusual pattern with regard to the floor of the third ventricle was noted here. This structure could be seen to project downward, draping itself across the top of the shortened posterior clinoids with the caudal aspect of the floor projecting into the cisternae interpeduncularis and pontis. When the floor of the third ventricle reaches the cisterna pontis it might well be termed a downward transtentorial herniation. This pattern has not been described before, so far as I could determine, and is quite different from the transtentorial herniations of the posterosuperior aspect of the third ventricle[4] and the median portion of the floor of the atrium of the lateral ventricles[1] reported by others.

When the third ventricle has dilated sufficiently to impinge on the posterior wall of the sella turcica this structure may be shortened by the constant pressure of the fluid-filled third ventricle. The bony density of the sella may remain fairly good if the cranial suture lines are open, but when these are closed pronounced sellar atrophy is usually present. That this is not specific for any single entity is emphasized by its occurrence in such diverse lesions as pineal tumors, aqueduct block, posterior fossa

arachnoiditis and posterior fossa tumors. The more indolent of these conditions are more likely to produce this change to a greater degree.

SUMMARY

1. Shortening of the posterior wall of the sella turcica may occur with certain midline lesions which cause pronounced dilatation of the third ventricle. The floor of the third ventricle in such cases may impinge against the posterior wall of the sella and protrude downwards into the cisternae interpeduncularis and pontis.

2. Shortening of the posterior sellar wall may also occur when a tumor mass such as a craniopharyngioma or an extrasellar pituitary adenoma impinges against it. In such cases the third ventricle plays no part in the shortening described.

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TRAUMATIC DIAPHRAGMATIC HERNIA*

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SINCE the advent of roentgenology, diaphragmatic hernia has become a clinically recognizable entity rather than a medical curiosity, and increasing numbers of reports of this condition have appeared in the literature. The rapid surgical advances which have made such lesions amenable to cure have also steadily augmented contemporary interest in this subject. It is notable, however, that in this growing experience the traumatic type has occupied a subordinate position in that no large reviews have been published and the majority of reports comprise one or two cases. The large surveys[1,8,9,10] have been concerned chiefly with the congenital and acquired types which, it is only fair to state, constitute the greatest proportion of diaphragmatic hernias. Nevertheless, with the present emphasis on speed in transportation, and the variety and number of crushing injuries, thoracic contusions, and steering wheel accidents, the incidence of traumatic diaphragmatic hernias is increasing. Such hernias were frequently reported as a sequel of World War I,[17] and with the large number of veterans from World War II who sustained thoracic and thoracico-abdominal injuries, a larger number of such cases may be anticipated. The more widespread employment of thoracic procedures involving the division of the diaphragm presents new potentialities for the occurrence of postoperative diaphragmatic hernia. Because of these current influences and because traumatic hernias offer special problems in diagnosis and treatment, it seems valuable to review the present status of accumulated experience, to integrate this knowledge, and to comment on points of unusual interest.

Traumatic diaphragmatic hernias arise as the result of direct or indirect trauma to the diaphragm. They have been classified into three main categories: (1) those caused by stab wounds, (2) those caused by gunshot wounds, and (3) those caused by indirect violence, such as falls, crushing injuries, and steering wheel accidents. We must now extend this classification to include: (4) those arising postoperatively from incision of the diaphragm. This type has not received widespread recognition, but it does occur and an increase in incidence may be predicted.

Several factors conspire to prevent prompt and firm healing of the diaphragm. It is believed that, after an opening has been made in the diaphragm, the negative pressure in the thorax causes ascent of intra-abdominal organs through the new orifice. A portion of the omentum commonly plugs the rent and separates the muscle fibers, preventing their subsequent union. The actual size of the opening in the diaphragm depends on many factors and varies a great deal. In general, it may be said that penetrating wounds cause smaller openings than does blunt trauma. Due to retraction of the cut ends of the muscle, a penetrating wound made at right angles to the direction of the muscle fibers causes a much larger rent than one parallel to the fibers. Hernias on the left side are far more frequent than those on the right (95 to 5 per cent),[10] although the latter do occur.[11] The liver tends to protect the right side, and even if rupture of the right leaf occurs, herniation is not likely unless the orifice is sufficiently large to allow entry of the liver into the thorax.

Because the opening may be small at first, because omentum exceeds all other viscera in its propensity to protrude

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through the dehiscence, and because that protrusion may be minimal, such potential hernias may defy early detection even when suspected clinically. Roentgenoscopic and roentgenographic examinations of the thorax may show normal mobility and outlines of the diaphragm. Later, usually during periods of increased intra-abdominal pressure, other organs may herniate and dramatically cause ill effects.

SYMPTOMS AND SIGNS

Diaphragmatic hernias are recognized during one of three phases:

1. *Immediately Following Accident.* The symptoms of traumatic hernia at its inception are hardly specific, because the trauma may produce shock and other serious injuries, which may disguise or overshadow the diaphragmatic injury. In injuries resulting from indirect trauma, the accident is commonly in the nature of a fall or a severe compression of the thorax or upper abdomen, the diaphragm being ruptured by a sudden bursting force. The tear may occur anywhere, but it frequently starts in the neighborhood of the esophageal hiatus, without communicating with it, and extends peripherally in any radius to the left of that point. In our experience these injuries are more frequently recognized at the outset than are those due to direct trauma. The very nature of the injury presupposes severe trauma, and usually requires careful roentgenological and clinical study. The rents, in contrast to those following stab or gunshot wounds, are usually large and the herniation of viscera occurs immediately so that roentgenologic findings are often diagnostic of rupture of the diaphragm.

Symptomatically, the patients show evidence of shock, there is severe pain in the upper abdomen, predominantly in the left upper quadrant, and there may be radiation of the pain into the left thorax or shoulders. Hematemesis sometimes occurs, due to herniation of the stomach with "pinching of imprisoned gastric vessels" (Marsden[13]). Dyspnea and cyanosis may occur. On physical examination dullness or tympany is present over the left lower thorax and there may be shift of the mediastinal structures to the right.

Recognition of severance of the diaphragm from gunshot or stab wounds is more elusive. In such cases damage to the diaphagram is obscured by the more immediate and obvious damage to the thoracic or abdominal viscera. If the opening is not large, abdominal viscera may not pass into the thorax, and the opening may merely be plugged by omentum. Thus, herniation of the viscera may not exist when the patient is first seen. Such hernias are apt to be discovered later, in the phase of obstruction or strangulation. Therefore, it is important to be aware of the possibility of penetration of the diaphragm. If the presence of such injury is not directly established by operative intervention, roentgenoscopic study of the diaphragm and barium studies of the gastrointestinal tract should be performed. The latter examinations should include study in the Trendelenburg position and with increase intra-abdominal pressure, both of which are useful in demonstrating herniation.

2. *Interval Phase.* Sometimes traumatic hernias are detected in what may be designated as the interval phase. This term describes the period following injury during which symptoms are either absent or of a chronic nature without becoming acute. The diagnosis is occasionally established in asymptomatic cases by fortuitous roentgenography of the thorax. In other instances, patients may present themselves with bizarre histories suggesting peptic ulcer, coronary disease,[5] gallbladder disease, or subacute intestinal obstruction. Such symptoms may be described as discomfort or oppression in the substernal, epigastric, or left thoracic regions, occurring after eating and frequently relieved by vomiting.[5,7]

3. *Phase of Obstruction or Strangulation.* We have recently studied the phenomenon of obstruction and strangulation in diaphragmatic hernias,[4] and found that 90

per cent of strangulated hernias are traumatic in origin. The chief reason for this is that the diaphragmatic defect is usually smaller in the traumatic variety and constriction of the blood supply to the involved viscus is therefore more likely. The interval between injury and strangulation may be extremely variable; as short as one day or as long as sixteen years. In 85 per cent of cases, however, strangulation occurred within three years of the injury. The acute attack generally begins abruptly. Pain is characteristically the initiating symptom and is usually sudden, severe, and localized to the upper abdomen or lower left thorax. Almost simultaneously the patient begins to vomit and may continue to do so without relief. Constipation is frequent and may precede the onset of the acute attack. In such cases it probably represents a precipitating factor since it likely causes greater intra-abdominal pressure and increases the tendency to herniation and strangulation. When it manifests itself after the onset of the acute attack it is associated with other signs of acute intestinal obstruction such as abdominal distention and hyperactive peristalsis. Although constipation has been noted with strangulation of the stomach, in such instances it generally precedes the attack and is not complete. Thus, the effectual movement of the bowels, normal peristaltic intestinal activity, and an undistended abdomen have presented serious confusion to the observer in those instances in which the stomach alone is strangulated. The obvious signs of acute obstruction are most prominent when the herniated organ is the small or large intestine; they are not nearly so pronounced in cases of obstruction of the stomach. Dyspnea is not frequent and its occurrence depends largely on the suddenness of onset and the degree of encroachment by the herniated viscera and by the accumulation of pleural fluid upon the cardiorespiratory system. Diagnosis in such cases is paramount. If the condition is unrecognized, death of the patient is almost certain. The diagnosis is easily made if its possibility is considered. The importance of eliciting a history of thoracic trauma cannot be overemphasized and physical examination of the thorax is extremely valuable. Abnormal findings over the left thorax are almost always present, and include dullness or tympany, evidence of pleural fluid, and pathognomonic extraneous signs such as borborygmi, gurgles, or peristaltic sounds. In a large number of cases there is a clinically demonstrable shift of the heart to the right.

The presence of fluid occurring in conjunction with strangulated diaphragmatic hernia deserves special comment. It occurs here as elsewhere with strangulation and may be markedly bloody. As much as 3.5 liters of fluid[14] and a red blood cell count of 1.9 million has been recorded. Unless this finding is appreciated, the correct diagnosis may not be made, for this phenomenon, although certainly not uncommon, has not been emphasized in the literature and on several occasions has led the observer astray.[4,6,14] Physical findings in the abdomen are in no way diagnostic. Attention is focused on the abdomen because of the presence of pain which, as such, is misleading. As with other types of intestinal obstruction, when the obstruction is low, pain is apt to be generalized, the abdomen may be distended, and other signs of intestinal obstruction may be present. If the stomach is obstructed, however, the abdomen may be scaphoid and in other respects normal. In such cases there is frequently bloody vomitus.

ROENTGEN DIAGNOSIS

In general, the diagnosis of traumatic diaphragmatic hernia may be readily made by roentgenologic examination. The most significant findings are: (1) an arch-like shadow resembling an abnormally high diaphragm; (2) extraneous shadows, such as gas bubbles, homogeneous densities, or other abnormal markings extending above the anticipated level of the normal diaphragm; (3) shift of the heart and medi-

astinal structures to the right (this is frequently present, and is dependent on the volume of viscera and fluid encroaching on the thoracic space); and (4) disc- or plate-like areas of atelectasis in the lung superjacent to the arch-like shadow. When one or more of these features suggest the possibility of hernia the diagnosis can be established conclusively by the following measures:

1. Roentgenoscopy of the thorax. This may reveal absence or decrease in the normal respiratory movement of the arch-like shadow which is actually the superior border of the herniating viscus.

2. Barium by mouth and/or barium enema. If the stomach is herniated, the barium meal will, as a rule, pass through the esophageal hiatus in a normal manner and immediately enter the stomach. If the obstruction caused by the hernial ring is slight, the barium will pass into the herniated portion of the stomach and pass distally into the duodenum, but there will be evidence of constriction at the proximal and distal portions of the herniated stomach. If the obstruction caused by the hernial ring is more complete, the barium may enter the herniated portion of the stomach but fail to pass distally. If the obstruction to the lumen of the stomach is complete no barium can enter the herniated portion of the stomach.

If the colon is herniated into the thorax, the barium clysma will take one of three courses: (1) It may enter the herniated portion of the colon and pass proximal to it. In this event the proximal and distal portions of the herniated segment will lie side by side at the level of the rent in the diaphragm and show constriction as they pass through it. (2) The barium may enter the herniated segment but obstruction may be encountered as the proximal loop passes through the torn diaphragm. (3) The barium may fail to enter the herniated segment. In such cases the point of obstruction is rather abrupt and shaped like an inverted funnel.

Certain misconceptions concerning the roentgenolgic findings in traumatic diaphragmatic hernia may lead to grave errors in diagnosis, and these deserve special emphasis. The herniated viscus can simulate the diaphragm in the lateral as well as in the anteroposterior projection, and a mistaken diagnosis of eventration of the diaphragm might readily be made if this point is not appreciated. The presence of gas in the herniated segment facilitates the diagnosis, but in some cases the herniated organ may contain no gas, and the correct diagnosis might be missed if one is not aware of this possibility. With strangulation, large amounts of fluid, usually bloody, can occur within the pleural cavity. An incorrect diagnosis of empyema has been made in such cases, and reports of ill-advised drainage of the thorax with resultant thoracogastric fistula have appeared in the literature.[12]

Roentgenologically, diaphragmatic hernia can readily be differentiated from eventration of the diaphragm and subphrenic abscess by the administration of barium by mouth or rectum and the demonstration of obstruction or constriction of the stomach or colon as it passes through the torn diaphragm well below the arch-like superior border of the herniated viscus. Free pleural fluid which has become trapped at the base of the thorax may resemble diaphragmatic hernia. This can readily be differentiated by means of a film of the thorax made in recumbency which will show the fluid distributed over the entire thorax and the diaphragm in its normal position.

TREATMENT

The treatment of traumatic diaphragmatic hernia is surgical and consists of repair of the diaphragmatic defect. When the hernia is obstructed or strangulated, immediate surgical therapy is imperative. In cases in which these complications do not exist, it is possible to delay definitive therapy in order to prepare the patient properly for operation. In patients presenting themselves immediately following in-

jury, the initial shock is of primary concern. Such patients usually improve and can be operated upon several days or weeks later. There is much difference of opinion as to whether the approach should be abdominal or thoracic. Even advocates of the transabdominal approach, however, concede that the *traumatic* hernia is best approached through the thorax,[1] because in many cases there are numerous dense adhesions between hernial contents and the thoracic wall which may be exceedingly difficult to release from below. The senior author in 1936[2] and again in 1948[4] cited the reasons dictating preference for the thoracic route. These advantages are: (1) excellent exposure is provided; (2) the herniated viscera are often adherent to the lung, thoracic wall, or diaphragmatic ring and must be freed from above under direct vision; (3) access to the diaphragmatic orifice is easily gained; and (4) when tears are located near the heart, sutures can be placed accurately and with less danger of wounding the heart, esophagus, and mediastinal vessels than through an abdominal incision alone.

In cases where the hernia is small and there is no strangulation or obstruction, the thoracic incision is generally sufficient and allows excellent visualization. If large amounts of viscera are incarcerated or strangulated, the thoracic incision should be extended across the costal margin into the abdomen where it may be continued as an upper transverse abdominal incision. Opportunity is afforded to inspect the strangulated abdominal organs and the surgeon can visualize the condition of viscera below the diaphragm while utilizing the advantages of the thoracic exposure.

Harrington[8] recently reported 55 traumatic cases with a mortality of 7 per cent. There is no mention of strangulation in his cases. Hedblom[9] pointed out in 1925 that when obstruction develops the mortality is doubled. In 126 collected cases with intestinal obstruction, he found the mortality to be 53.1 per cent. At the Cincinnati General Hospital 9 cases of traumatic diaphragmatic hernia have been subjected to operation since 1932 with one death, a mortality of 11 per cent. Six of these cases were complicated by obstruction, and 4 of these had strangulation. The one death in the series occurred in the latter group.

The following cases present some of the manifold problems associated with traumatic diaphragmatic hernia and serve to illustrate the usual difficulties encountered. The first 3 cases exemplify the typical picture of hernia occurring immediately after indirect trauma.

CASE 1. (Previously reported by B. N. Carter.) J. B., female, aged eight, was admitted to the Cincinnati General Hospital in August, 1932, a few minutes after she had been struck by an automobile. It was thought that the car passed over her abdomen and chest. She was in profound shock and nearly moribund. Hasty examination revealed multiple fractures of the ribs on the left side and some contusions of the abdomen. She was extremely dyspneic and cyanotic with a very weak and rapid pulse. The usual measures for shock were begun and she was placed in an oxygen tent. Her condition was precarious for a day or so after which she made a rapid convalescence. Diaphragmatic hernia had not been suspected, but a roentgenogram of the thorax taken during convalescence showed the colon in the left pleural cavity. A barium meal was given and demonstrated that portion of the stomach, small intestine, and colon were in the left thorax. The patient was not operated on at this time as it was believed that her condition did not warrant surgical intervention. She was discharged and kept under observation. In October, 1934, two years after her injury, she was readmitted complaining of pain in the left thorax and violent attacks of dyspnea, particularly after meals. It was obvious that the hernia had to be repaired. Under endotracheal anesthesia the thorax was opened along the seventh interspace. About 12 inches of colon, 2 feet of small intestine, the left lobe of the liver, the stomach, and the spleen were found in the thorax. A rent in the diaphragm was found extending from the aortic hiatus diagonally forward across the dome almost to the edge of the diaphragm about the level of the eighth rib. The viscera were easily reduced and the diaphragm was repaired with interrupted ligatures of double medium black silk imbricating the

edges. Her convalescence was uneventful and on discharge her left lung was shown roentgenologically to be expanded and the hernia apparently cured.

Case II. R. R., eight year old white male, was admitted to the Cincinnati General Hospital on January 28, 1948, after an accident in which the wheels of a truck passed over his abdomen. Shortly after the accident he vomited blood. On roentgenography the left leaf of the diaphragm could not be seen and the gas bubble of the stomach appeared in the left thorax. He was in good general condition with no evidence of pain. Blood pressure 94/50, pulse 100, respiration 24. Ecchymosis over the lower abdomen and about the area of the left iliac spine was noted. On percussion the right border of the heart was shifted slightly to the right and the left border could not be made out. There were suppressed breath sounds in the lower two-thirds of the left thorax and percussion note was dull. Occasional peristaltic sounds were heard as high as the fifth intercostal space. The abdomen was scaphoid. Spasm, rigidity, and pain with tenderness were elicited in the left upper quadrant, and peristalsis was active. A second roentgenogram of the thorax revealed some shift of the heart to the right and apparent herniation of the stomach into the left thorax with compression of lung tissue at the left base. A large fluid level was seen in the stomach, and was confirmed by barium meal. The diagnosis of traumatic diaphragmatic hernia was made and operation was performed the same day. The thorax was entered through the bed of the resected seventh rib. Stomach, spleen, omentum, transverse colon, and small intestine were found to have herniated through a large rent in the diaphragm starting 1 cm. lateral to the esophageal hiatus and running laterally to the thoracic wall. None of the herniated organs was injured except for obvious subserosal hemorrhages in the small intestine 24 inches beyond the ligament of Treitz and some hemorrhages in its mesentery. The viscera were returned and the rent closed with figure of eight sutures of double medium black silk. The postoperative course was smooth. He was discharged on February 7, 1948.

Case III. R. M., twenty-two year old white male, was admitted to the Cincinnati General Hospital in October 1946 following an automobile accident. He was intoxicated. After admission he began vomiting coffee-ground material and went into shock. Following plasma, his blood pressure returned to 120/80 with a pulse of 120. He voided 8 ounces of grossly bloody urine. On physical examination he was pale, appeared acutely ill, and was retching. His thorax was resonant to percussion and breath sounds were heard bilaterally. His abdomen was flat and there was moderate abdominal spasm with rebound tenderness in the epigastrium. Roentgenogram showed the heart and mediastinal structures displaced to the right. A large pocket of gas and fluid density with a well defined rounded superior margin occupied the left lower thorax up to the seventh rib posteriorly. Immediately above this there was compression, of the left lower lobe. There were two fluid levels at the left base.

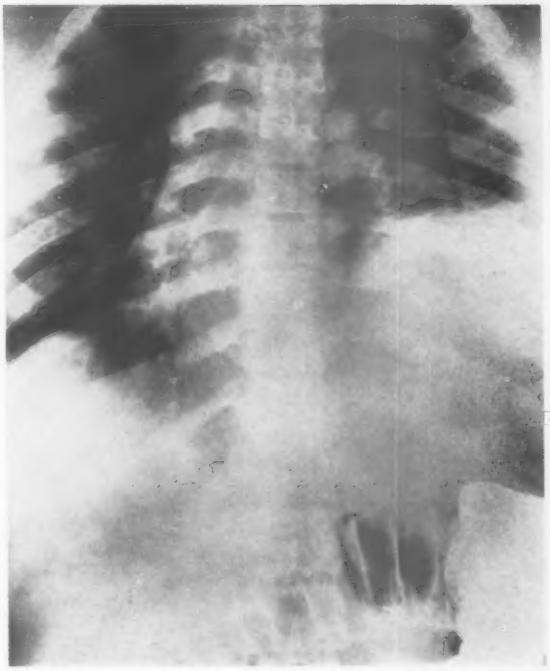

Fig. 1. Case VII. The arch-like shadow in left thorax simulating a high diaphragm is actually due to the herniated stomach. Note displacement of heart and trachea.

He was treated conservatively for approximately a week. Barium swallow revealed the stomach in the left thorax. Thoracotomy was performed two days later with incision through the bed of the resected seventh rib. About two-thirds of the stomach together with herniated omentum was reduced and the diaphragm closed. The rent extended 12 cm. in length from the esophageal hiatus anteriorly and laterally. The postoperative course was uneventful.

Comment. The diagnosis in this type of case is not especially difficult. The occurrence of a crushing injury should always suggest the possibility of traumatic diaphragmatic hernia, although if the patient recovers from the initial shock his good general condition may belie internal trauma. Vomiting of blood occurring at this stage is strong evidence that the stomach is included in the herniation. A film of the thorax taken in the upright position is usually adequate to confirm the diagnosis. When there is no obstruction, herniation itself does not constitute need for emergency surgery. These patients benefit by treatment for shock and concurrent injuries. At a later period when their general status is much improved, surgical repair of the defect should be undertaken.

The next 2 cases are examples of herniation due to indirect trauma which was not detected at the time of injury and in which the patients returned subsequently with strangulation and obstruction respectively.

CASE IV. (Previously reported by B. N. Carter.) G. H., colored female, aged forty-five, was admitted to the Cincinnati General Hospital on October 1, 1933, complaining of cramp-like pains in her abdomen. Ten weeks before admission she had fallen from a third story window and suffered a central dislocation of her left hip. During her hospitalization for this she had no symptoms referable to her abdomen or thorax, but physical examination on discharge revealed dullness in the base of the left thorax. No roentgenograms of the thorax were taken. Two days before the present admission the patient began to have cramp-like pains in the abdomen immediately after eating. These pains occurred particularly in the left upper quadrant and in the left lower thorax, and were referred to the left shoulder and neck. There was a sensation of suffocation and palpitation. The patient vomited almost everything she had eaten the previous day and there had been obstipation for two days.

Physical examination showed a thin Negro female who was suffering acute cramp-like pains. There was dullness and flatness in the lower left portion of the thorax. Auscultation showed striking peristaltic noises in the thorax

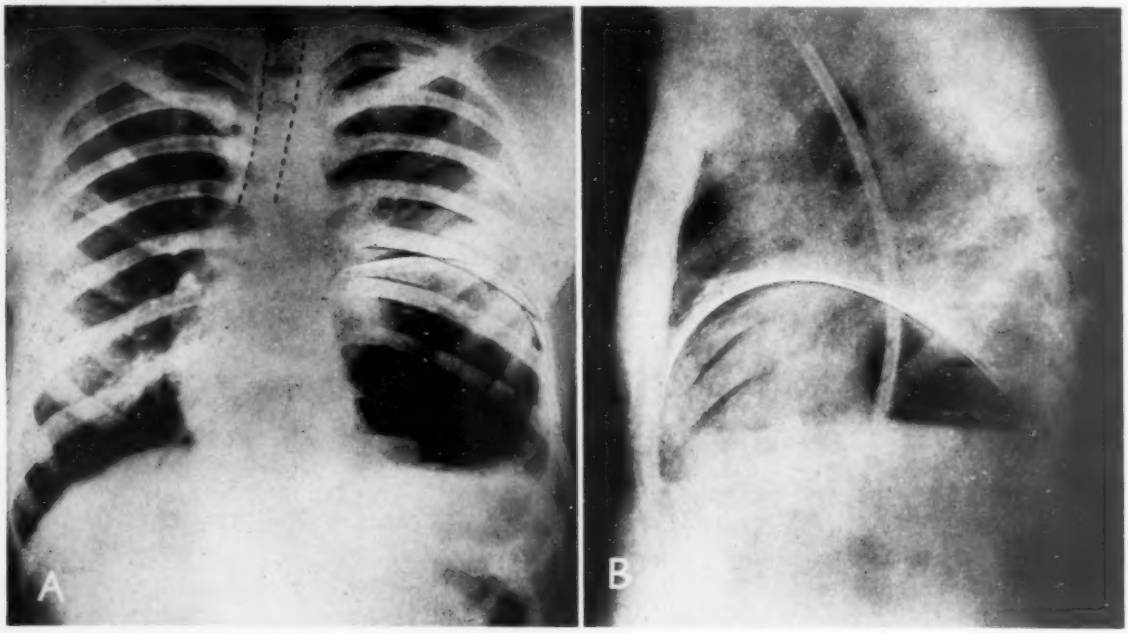

FIG. 2. Case III. Anteroposterior (*A*) and lateral (*B*) views showing the similarity to an elevated diaphragm of the shadow produced by the herniated stomach. The heart and trachea are displaced and there are disc-like areas of atelectasis in the compressed left lung. (Retouched.)

which could be heard without the aid of a stethoscope. The abdomen was slightly rounded and tense. Many peristaltic sounds were heard over the abdomen. A diagnosis of diaphragmatic hernia with intestinal obstruction was made and confirmed by roentgenological examination with the patient in the sitting position. The outline of the large intestine could be seen in the lower left thorax without the aid of opaque material.

The patient was operated upon immediately through a high midline abdominal incision, and dilated large intestine was seen to disappear through a defect in the diaphragm. Complete reduction could not be effected until the opening in the diaphragm was enlarged by a lateral incision. Nine inches of colon were found in the thorax. The bowel was viable though dark red in color, and there was about 150 cc. of blood-tinged fluid in the left pleural cavity. The opening in the diaphragm was immediately anterior to the esophagus. The edges were indurated and fibrotic, indicating that the hernia had been present for some time. The rent in the diaphragm was closed with double medium silk sutures and the abdomen was closed in the usual manner. Convalescence was uneventful. Subsequent roentgenograms have shown the hernia to be cured.

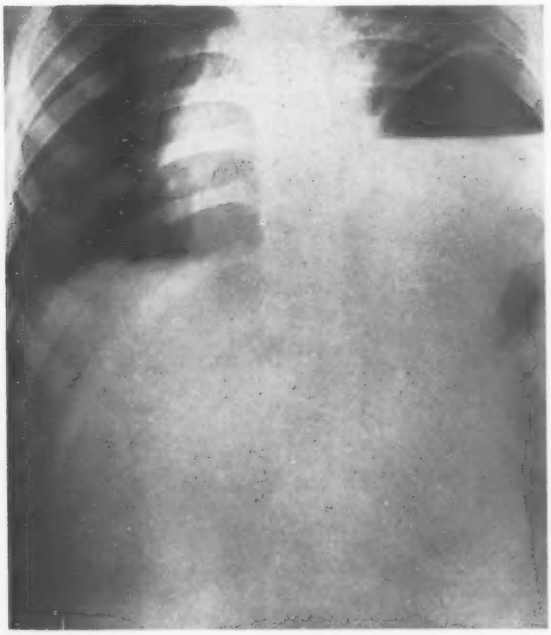

Fig. 3. Case II. Extraneous gas bubble in left thorax caused by herniated stomach.

Fig. 4. Case X. Extraneous gas bubble in left thorax produced by herniated loop of colon.

Case V. D. J., twenty year old white male, was admitted to the Cincinnati General Hospital in October, 1946, following an automobile accident. Findings suggested a ruptured intra-abdominal viscus with pain and tenderness in the upper abdomen. The shock and abdominal symptoms cleared with supportive therapy and he signed himself out of the hospital twelve hours after admission. He was readmitted in September, 1947, eleven months later. On the day of admission he had awakened at 6:30 A.M. with severe upper abdominal pain, intermittent and cramp-like in character. This pain persisted throughout the day with nausea and frequent retching, but no vomiting. He had one normal bowel movement. On admission he was acutely ill; blood pressure was unobtainable and pulse was 180. He was noted to retch continually, producing only frothy white material. The trachea and cardiac dullness were shifted to the right. There were diminished resonance and breath sounds in the base of the left thorax. The abdomen was soft and not distended, but generally tender. Roentgenogram of the thorax showed the trachea and heart deviated to the right and what appeared to be a high left leaf of the diaphragm. A barium swallow showed that the barium passed readily into the stomach, which was in normal position. A diag-

nosis of diaphragmatic hernia with obstruction was made on the basis of the history and characteristic physical and roentgenological findings. The patient was prepared with whole blood, and four hours later was explored through a combined thoracicoabdominal incision. There was a rent in the diaphragm, 6 by 4 cm. in size, located in the central tendinous portion through which the splenic flexure, omentum, and jejunum were herniated. The viscera were reduced and the rent in the diaphragm repaired. Postoperative course was uncomplicated.

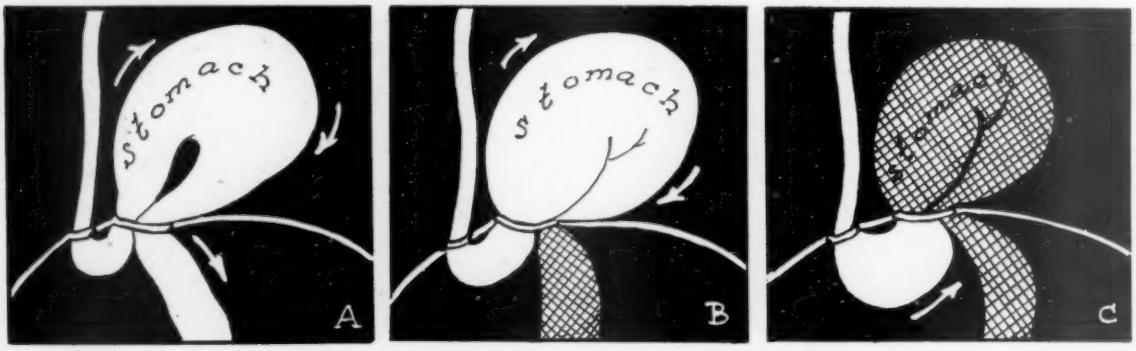

FIG. 5. Diagrams illustrating the various results which may be obtained following barium meal in cases of herniation of the stomach.

Comment. Both of these cases were initially undetected. Case v illustrates the rapid recovery and minor disability which may follow, once the initial shock has disappeared. Case IV had obvious physical signs which should have made the observer suspicious and indicated the need for roentgenologic study of the thorax. Case IV was approached transabdominally and Case V through a thoracicoabdominal incision. At the present time both would be treated with incision through the thorax and extension into the abdomen if necessary for appraisal of conditions below as well as above the diaphragm.

FIG. 6. Case III. The barium meal has entered the herniated stomach but is unable to pass the constriction of the hernial ring. (Retouched.)

The next case illustrates the type of hernia resulting from a stab or gunshot wound, observed in the phase of obstruction.

CASE VI. W. C. white male, aged twenty-three, was first admitted to the Cincinnati General Hospital in 1938, shortly after receiving multiple stab wounds of the left side and back. His pulse was 90 with a blood pressure of 143/80. Respirations were shallow, labored, and rapid, with a rate of 40. There was marked pallor. Local examination revealed three stab wounds; one in the ninth interspace anterior axillary line on the left, with a 2 inch plug of omentum protruding through the opening, one in the eighth interspace midaxillary line on the left, and one in the seventh interspace one and one-half inches to the left of the spine. The trachea, heart and mediastinal structures were shifted to the right. The left thorax was tympanitic with distant breath sounds, and there were many coarse rales. The abdomen was moderately rigid with tenderness in the left upper quadrant and flank. The initial impressions were: (1) stab wounds of the left thorax; (2) penetrating stab wound of the left abdomen (transpleural); (3) hemopneumothorax. A film

of the thorax secured on the day of admission showed some cloudiness in the left costophrenic angle. No definite evidence of parenchymal infiltrate or pneumothorax was seen. The omentum was replaced in the thorax and the wound was closed with two black silk sutures.

Comment. This case illustrates the indifference usually evidenced in wounds which might involve the diaphragm, and emphasizes the importance of the present discussion. The significance both of the presence of a wound so placed as to suggest possible involvement of the diaphragm and of the actual protrusion of a portion of omentum through this wound was over-

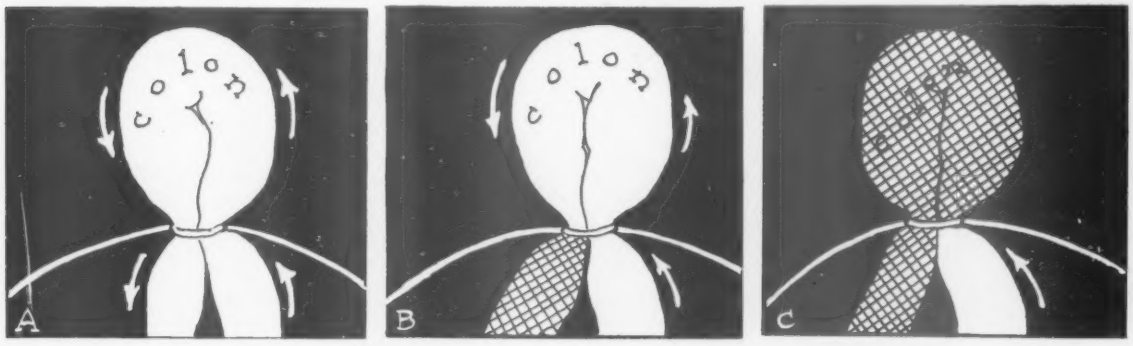

Fig. 7. Diagrams illustrating the various results which may be obtained following barium clysma in cases of herniation of the colon.

Thereafter he was observed and was discharged well, one week later.

He was next seen on June 13, 1947, nine years later. Forty-eight hours before admission he had complained of abdominal bloating and twenty-four hours later had noted the onset of left upper quadrant and left flank pain, dull and aching in character. Roentgenogram of his left thorax was interpreted as revealing a left pleural effusion. His pain subsided, but recurred more severely that evening. He attempted to eat, but immediately vomited. He had a small constipated stool the night before admission.

The pertinent findings in the physical examination revealed the aforementioned healed scars, dullness in the base of the left thorax, and some cardiac shift to the right. The history, however, suggested the possibility of a diaphragmatic hernia with obstruction, and gastrointestinal series and barium enema was done, revealing herniation of the splenic flexure of the colon.

Operation was performed the same day. The thorax was entered through the seventh interspace. Exploration revealed almost the entire transverse colon, splenic flexure, and an estimated 3 pounds of omentum to be in the thorax. The bowel was adherent about the entire circumference of the opening. The organs were reduced and the diaphragmatic defect closed with mattress sutures of medium black silk. Recovery was uneventful.

Fig. 8. Results obtained by barium clysma in Case x. Note that the two arms of the loop of colon lie side by side and each is indented where it passes through the diaphragm. (Retouched.)

looked. Although an opening in the diaphragm had been present for many years it had caused no symptoms until obstruction occurred.

The following 3 cases illustrate the phenomenon of strangulation in cases due to stab and gunshot wounds. Strangulation is defined as arrest of circulation due to compression.

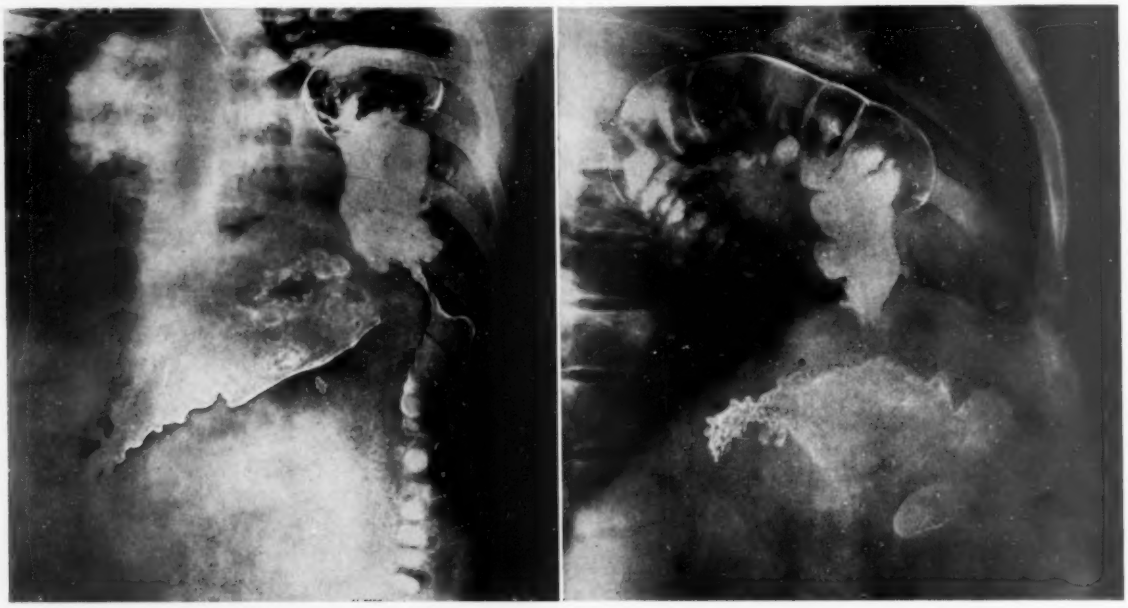

FIG. 9. Result of a barium clysma in Case VI. The barium has entered the herniated loop of colon through an area of constriction but it cannot pass the constricting ring of diaphragm. (Retouched.)

CASE VII. (Previously reported by Carter and Giuseffi.) A. G., colored male, aged thirty-three, was admitted to the Cincinnati General Hospital on April 13, 1947, with a history of cramp-like, non-radiating, epigastric and left upper quadrant pain for twenty-three hours. This pain was persistent and had been accompanied by vomiting of food without blood for ten hours. From the time of onset there had been complete constipation. Two months previously he had been admitted with two stab wounds of the thorax, a sucking wound of the right posterior thorax, and another in the left fifth interspace in the axillary line. There had been some doubt as to whether the latter had penetrated the pleura. A right hemopneumothorax developed after wound closure, but convalescence was otherwise uneventful and he had returned to heavy labor.

Physical examination revealed a well nourished colored male who appeared acutely ill. There was dullness up to the sixth interspace and the diaphragm did not move on deep respiration. The abdomen was not distended; peristalsis was generally hypoactive. There was an indefinite, vertically placed, fairly firm mass in the left lower abdomen, which was slightly tender and dull on percussion. Rectal examination was negative. Transient "gurgling noises" in the thorax were noted by one observer. Roentgenograms showed a "high left diaphragm" and displacement of the heart to the right; film of the abdomen showed gaseous distention of the large and small intestine. Barium enema revealed mesial and upward displacement of the sigmoid colon, but good filling and no evidence of obstruction. A diagnosis of left subphrenic abscess or delayed rupture of the spleen was considered. Several hours after admission he suddenly manifested signs of shock with peripheral circulatory collapse. At this time the left thorax had become dull to percussion up to the second interspace. Thoracentesis produced 550 cc. of fluid which resembled pure blood and had a red blood cell count of 1.9 million. Transfusion of 500 cc. of whole blood was followed by a rise in blood pressure. During the next few hours an additional 1,000 cc. of

bloody fluid were removed from the left thorax. The following morning he manifested signs of increasing shock despite continuous blood transfusion. Repeat film of the chest showed increased fluid in the chest; increased mediastinal shift to the right; and unchanged position of the "high diaphragm."

At exploration through a combined thoracicoabdominal incision, the stomach and spleen were found to be herniated through a rent in the diaphragm and the former to be entirely gangrenous save for a small segment of the greater curvature at the cardiac end. The entire omentum was gangrenous. There was an estimated 1,000 cc. of bloody fluid in the pleural cavity. The gangrenous portion of the stomach was resected and a postcolic Polya type gastrojejunostomy was performed, only the small cardiac portion of the stomach remaining as a pouch. The spleen and all of the omentum were removed.

Postoperatively there was evidence of improvement for twelve hours. Respirations then became shallow and rapid, cyanosis could not be controlled by oxygenation or bronchial aspiration, and the patient died the day after operation. At necropsy no immediate cause of death was discovered. The anastomosis was intact. The mass in the lower left quadrant was a prolapsed kidney.

Comment. The correct diagnosis in this case was not made until the thorax had been opened at operation. In retrospect the confusing features were: (1) the "high diaphragm" which was in reality the herniated stomach whose appearance on the roentgenogram accurately simulated that of an elevated diaphragm but was not identified as stomach because of the absence of a fluid level; (2) the absence of abdominal distention which was due to the stomach *alone* being herniated through the rent in the diaphragm; and (3) the presence of floody fluid in the left thorax. The features which should have suggested the proper diagnosis were: the history of a penetrating wound of the thorax, the marked vomiting not productive of bile, the dislocation of the heart to the right, and the dullness in the left lower thorax.

Case VIII. (Previously reported by Carter and Giuseffi.) W. H., colored male, aged thirty-five, was seen in the receiving ward of the Cincinnati General Hospital on May 31, 1947, by a medical consultant. His illness had begun six days previously when, following an alcoholic debauch, he was seized with acute agonizing pain in the region of the epigastrium with radiation into the left thorax and both shoulders. He immediately vomited and continued to do so on the days following. He was severely constipated and passed no feces or flatus except for two or three lumps of hard stool after an enema. Past history revealed that he had suffered a skull fracture in 1920 and a stab wound in the left lower thorax in 1939.

Physical examination revealed a sweating, orthopneic, dyspneic colored male. Temperature was 100.2° F.; blood pressure 130/90; pulse 120; respiration 40. Dullness to flatness was noted on percussion over the left lower thorax and absent to diminished breath sounds were found in the same area. A scar was present over the seventh rib in the left anterior axillary line. The abdomen was diffusely distended. There was voluntary muscle spasm but no localizing tenderness. No peristalsis could be heard.

Clinical diagnosis was left lower lobe pneumonia with paralytic ileus on the basis of pneumonia. A roentgenogram of the thorax was secured and revealed what was thought to be a high left diaphragm. The diagnosis of probable subphrenic abscess was entertained and surgical consultation was requested. The tentative diagnosis of strangulated hernia was made on the basis of the medical consultant's report, and examination of the patient revealed these confirmatory findings: the left thorax was dull posteriorly, as previously described, and the lower portion anteriorly was decidedly tympanitic; the apex beat of the heart was noted to be in the fourth interspace to the right of the sternum; review of the roentgenogram revealed that the heart and mediastinal structures were shifted to the right, a homogeneous density containing an area of radiolucency occupied the lower half of the left thorax and the left diaphragm could not be identified; flat and erect films of the abdomen showed the pattern of large bowel obstruction, and gas was noted in the large bowel as far distally as the splenic flexure; upon barium enema obstruction was encountered at the splenic flexure.

Operation was performed immediately by a combined thoracicoabdominal incision. A portion of the transverse colon and the splenic

FIG. 10. Result obtained by barium clysma in Case IX. Note the inverted funnel appearance caused by the constriction of the colon where it passes through the diaphragm, that there is a very small amount of barium in the herniated loop and that it fails to pass into the proximal colon.

flexure had herniated into the thorax through an opening in the anterior half of the left diaphragm that would accommodate only two fingers. Approximately 600 cc. of non-odorous bloody fluid were found in the pleural cavity. The 10 inch segment of herniated colon was greatly dilated and purple in appearance. Upon reduction, its color improved noticeably but there was a 4 cm. area of bowel which retained a mottled black appearance and was of questionable viability. The strangulated bowel was reduced into the abdomen after the opening in the diaphragm had been greatly enlarged. The thoracic portion of the wound was closed after the diaphragm had been repaired. The questionable loop of bowel was exteriorized as a double barrled colostomy and the abdomen was closed with silver wire. In addition, a cecostomy was performed. The postoperative course was satisfactory. On the third postoperative day the wound was dressed, the segment of bowel in question was found to be completely gangrenous, and was resected. The patient was maintained on penicillin and sulfadiazine therapy. Six weeks later the colostomy was closed by side-to-side anastomosis, and the cecostomy was closed several weeks thereafter.

Comment. This case illustrates the ease with which diagnosis can be made when one is cognizant of the signs and symptoms of strangulated diaphragmatic hernia. Case VII had been so striking and so recent that the similarity to Case VIII could be noted even in the history. The diagnosis was readily made from the history of previous penetrating wound of the left lower thorax, the signs of intestinal obstruction, the displacement of the heart, the roentgenologic findings suggesting high left diaphragm, the signs of fiuid in the left thorax, and the barium enema. No thoracentesis was performed, but at operation there were 600 cc. of bloody fluid in the thorax. A combined incision was made because of the tremendously distended loop of colon which could not be reduced through the exposure afforded by either a thoracic or abdominal approach.

CASE IX. (Previously reported by Carter and Giuseffi.) E. L., white male, aged twenty-six, was admitted to the surgical service on December 26, 1944. One week earlier he had been seen in the receiving ward of the Cincinnati General Hospital complaining of sharp sudden lower abdominal pain of knife-like character, associated with nausea and vomiting. A diagnosis of gastroenteritis was made and he was referred to his local physician. For the ensuing seven days he was bedfast at home, suffering severe abdominal pain which became more generalized and then moved to the left flank and the left costovertebral angle. During that time he vomited frequently, had no bowel movements, and did not pass any flatus. Past history revealed that he had been admitted to the Cincinnati General Hospital for a penetrating gunshot wound of the thorax eighteen months previously, at which time it was thought that the bullet had traversed both lungs and probably perforated the lower end of the esophagus. At that time he developed bi-

lateral hemothorax, pericarditis, and on his fourteenth hospital day had a sudden internal hemorrhage manifested by several tarry stools. He recovered with conservative therapy.

Physical examination on the present admission revealed an acutely ill white male, temperature 100.4° F., and blood pressure 96/70. There was a healed gunshot wound in the mid-axillary line at the level of the sixth rib and another on the posterior aspect of the right thorax. Percussion note was hyporesonant over the left base posteriorly. The abdomen was moderately distended with slight voluntary spasm chiefly on the left side and peristalsis was absent. No masses or organs were felt. Laboratory tests revealed the following: white blood cell count, 12,400; hemoglobin, 13.5 gm.; urine, negative; serum chlorides, 340. A flat film of the abdomen showed many dilated loops of small bowel with multiple fluid levels. Diagnosis of intra-abdominal abscess with resultant ileus and obstruction was made.

The day after admission he was noted to have signs of fluid in the left thorax. Thoracentesis was performed and 150 cc. of foul-smelling serosanguineous fluid were withdrawn. This fluid had a specific gravity of 1.020, and on smear was found to contain gram-positive cocci and gram-negative rods. Diagnosis of strangulated diaphragmatic hernia with empyema formation was made. Roentgenologic examination of the thorax revealed marked displacement of the heart to the right and clouding of the left lung field. Barium enema showed the colon to be normal as far as the splenic flexure, where there was an annular constriction 2–3 cm. in length through which a very small amount of barium passed.

Because of the patient's poor condition, cecostomy and closed thoracostomy were immediately performed, followed a week later by a Devine colostomy, and repair of the hernia by the thoracic route seven weeks later. Two months thereafter the colostomy was resected with end-to-end anastomosis. Postoperative course throughout these procedures was stormy and the patient left the hospital against advice on May 14, 1945.

Comment. This case exemplifies one of the complications which may develop if strangulation is allowed to progress unrecognized until contamination of the thoracic cavity occurs. In such cases empyema develops, and it is probable that certain of these cases have been treated for pleural disease without recognization of the underlying pathology. Such a case was reported by Slater and MacKenzie[15] in 1923. More recently,[12,16] somewhat similar cases have been reported in which the hernia was confused with empyema, and after trocar or catheter drainage was performed, thoracogastric fistula ensued with grave results to the patient. The correct diagnosis was not immediately made in our case although the history of a penetrating wound of the thorax in the region of the diaphragm, signs of intestinal obstruction, physical findings referable to the left lower thorax, and displacement of the heart to the right were present. Only after foul-smelling fluid had been aspirated from the thorax was the correct diagnosis suspected and confirmed by barium enema. This case also illustrates another method of treatment in advanced cases with perforation: cecostomy for decompression of the bowel plus local drainage at the site of strangulation. Repair of the hernia can then be undertaken via the thoracic route when the patient is in suitable condition.

In a previous consideration of the problem of strangulation,[4] review of the literature emphasized the striking consistency of the history and physical findings in these cases, namely: (1) the history of a previous thoracic injury; (2) physical findings referable to the left thorax, particularly displacement of the heart to the right, dullness or tympany in the lower portion of the thorax, adventitious sounds, and aspiration of bloody fluid from the left pleural cavity; (3) roentgenologic findings suggestive of a high left diaphragm with displacement of the heart to the right; and (4) signs of acute gastrointestinal obstruction with particular emphasis on the fact that where the stomach alone is strangulated there is absence of abdominal distention and a patent intestinal tract. Cases VII, VIII and IX show striking conformation to this pattern.

The next 2 cases are examples of a type

of hernia which has been seen recently. They indicate a complication of thoracic and thoracicoabdominal surgery of which we must be more aware.

CASE X. M. B., white male, aged sixty-two, was admitted to the surgical service of the Cincinnati General Hospital on May 7, 1948, with squamous cell carcinoma, Grade 3, of the lower third of the esophagus, proved by biopsy. On May 24, 1948, resection of the lower third of the esophagus with esophagogastrostomy was performed. In this procedure the diaphragm was divided from the rib cage to the esophageal hiatus. The diaphragm was closed with closely spaced interrupted sutures of medium black silk. The esophageal hiatus was reconstructed about the antral level of the stomach. The ventral surface of the stomach was joined to the edge of the diaphragm with several interrupted sutures of medium black silk. Jejunostomy was also performed for feeding purposes. The patient's course was satisfactory following the procedure, but three months later barium enema was done because the colon had appeared to lie unusually high on previous films. This study showed that the splenic flexure and a considerable segment of the distal transverse colon lay above the diaphragm. No significant obstruction to the flow of barium was noted at the site of the defect in the diaphragm. When the patient was last seen in follow-up clinic, there was no evidence of obstruction of the colon or of recurrence of the carcinoma.

CASE XI. R. S., white male, aged fifty, was admitted to the otolaryngological service of the Cincinnati General Hospital because of a progressive dysphagia over a period of six weeks. The patient had a history dating back to 1934 of intermittent bouts of vomiting, substernal distress, and weight loss. In 1945, while in North Carolina, his symptoms became severe and he was admitted to a hospital there.

A transcript of his record revealed that a diagnosis of benign stricture of the esophagus was made, the thorax was entered on the left through the bed of the resected seventh rib, and the esophagus was exposed. "The diaphragm was then split in the anterior lateral direction, the lower third of the esophagus and the upper portion of the stomach were resected and an end-to-side esophagogastric anastomosis was performed." The rent in the diaphragm was closed with interrupted sutures of black silk and the opening closed snugly about the stomach. The superior surface of the diaphragm was then sutured to the stomach which protruded above the diaphragm. On microscopic examination no evidence of malignancy was found.

He was well thereafter until his present illness. On barium study he was found to have what was interpreted as a complete stricture at the junction of the middle and lower thirds of the esophagus. Eighteen months after his initial operation, he was transferred to the surgical service where, on October 18, 1946, a Witzel jejunostomy was performed for feeding purposes in preparation for definitive surgery. Postoperatively he developed a massive hydrothorax. His left thorax was tapped repeatedly and in all about 5,000 cc. of clear amber fluid with a specific gravity of 1.012 were obtained. He did well until October 26, 1946, when he became very weak and went into shock. Aspiration of the jejunal tube gave dark blood. Despite administration of blood and oxygen he died on October 26, 1946.

Necropsy revealed a stenosis of the esophagus at a point about 5 cm. below the bifurcation of the trachea. The site of the anastomosis was patent. There was a rent in the diaphragm which was continuous with the esophageal hiatus, four fingerbreadths in length in a horizontal direction. The splenic flexure and a portion of the jejunum had herniated into the left thorax and the left lung was collapsed. Within the peritoneal cavity there was a volvulus about the jejunostomy causing gangrene of a sizable length of small intestine. The organs within the hernia, although incarcerated, were not gangrenous.

Comment. Both of these cases are examples of hernia following surgical incision of the diaphragm. In the first, the hernia occurred soon after surgery, was quite large, and was attributable to an almost complete failure of the diaphragmatic wound to heal. Whether in the last case case herniation existed prior to the terminal episode is a matter difficult to decide.

SUMMARY

1. Diaphragmatic hernia frequently results from penetrating injuries of the diaphragm or from rupture by indirect violence. Because of the large number of wounds involving the diaphragm in World

War II and the increasing incidence of crushing injuries resulting from automobile accidents, a greater number of patients with diaphragmatic hernia are being seen.

2. Diaphragmatic hernia may be recognized at the time of injury, during an interval stage, or after obstruction or strangulation has occurred.

3. Since the mortality is greatly increased when strangulation has occurred, the herniation should be recognized and treated before strangulation takes place.

4. In cases with intestinal obstruction, the need for prompt surgical intervention is obvious; when the stomach alone is involved, this need may not be apparent.

5. The diagnosis can be definitely established by roentgenologic examination, which should always be made when there is a history suggesting possible injury to the diaphragm.

6. The repair of traumatic diaphragmatic hernia is best accomplished through a thoracic approach with an abdominal extension when greater exposure is required.

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DISCUSSION

Dr. Charles M. Barrett, Cincinnati, Ohio. For some time the attention of the Department of Radiology at the College of Medicine, University of Cincinnati, has been directed toward traumatic herniations through the diaphragm. This has been mainly at the behest of Dr. B. Noland Carter, Professor of Surgery, who has manifested an interest in lesions of the thoracic cage. In 1936, Dr. Carter reported traumatic diaphragmatic hernia, and suggested the thoracicoabdominal approach in management of this lesion. Dr. Carter and his associates have been in an unusually favorable position to study injuries of the thoracic cage because of the large traumatic service of the Cincinnati General Hospital. The relatively stable community with high industrial development promotes traumatic episodes which lend themselves to treatment at the Cincinnati General Hospital. The efficiency of the emergency service and the concern for this type of case by the Departments of Surgery and Radiology are all factors which tend to improve the diagnostic abilities of surgeon and radiologist alike. From this mutual experience, the

Department of Radiology has been particularly benefited since we now feel in a better position to recognize the possibility of traumatic herniations of the diaphragm than ever before.

Dr. Felson has indicated in his description of the method of roentgen diagnosis a satisfactory procedure in determining the presence of traumatic hernias. In several of the cases the diagnosis was obscure in the early phases. but pursuance of the aforementioned methods brought about the correct analysis. The roentgen picture was indeed confusing in several of the cases described by Dr. Carter and his associates, and one is certainly impressed with the need for remembering this possibility following direct or indirect abdominal or thoracic injury. The number of cases presented here is not large, although it constitutes a fairly considerable relative amount. Hence one may speculate that the incidence of traumatic diaphragmatic hernia is actually low in view of the great number of traumatic incidents which occur.

While Dr. Carter has mainly dwelt upon the injuries to the diaphragm that result in hernias, certainly it would appear that injury to the abdomen may cause protrusion of a viscus through the esophageal hiatus because of weakening of this hiatal ring. It is quite probable that many cases of hiatus hernia are actually traumatic in origin rather than congenital. One might parallel the esophageal hiatus hernia to an indirect inguinal hernia, while the traumatic diaphragmatic hernia may be analogous to the direct inguinal hernia through Hesselbach's triangle. It is also interesting to speculate upon the geographic location of hernias which do not present through the hiatal aperture. These may be in some fashion a combination of trauma and congenital weakness. The embryologic sites of fusion of the leaves of the diaphragm may not be complete in some individuals, and relatively minor injuries could produce herniations. Such herniations through the spaces of Bukdalect or Morgagni may then in part be due to an improper fusion of the diaphragmatic leaves. I would therefore like to present the question to Dr. Carter, cannot hernias occur through the hiatal orifice which are traumatic and do not involve rent in the diaphragm? Is not increased intra-abdominal pressure enough to push a viscus through the esophageal hiatus, or perhaps even widen the sphincter? I should also like to ask Dr. Carter the commonest location of the traumatic hernia as regards to the anterior or posterior leaves of the diaphragm. Gross hemorrhage was mentioned by Dr. Carter as occurring in several cases. The presence of hematemesis in association with chest or abdominal injury must be regarded with suspicion. The use of a Levin tube for evacuation of the stomach may be of great help in locating herniation. It has also been noted by others that the lateral decubitus film may be useful in determining the presence of hernia.

One case not reported in the series by Dr. Carter is an individual whose roentgenograms were seen by both of us several years ago. This patient had been injured in an automobile accident approximately thirteen years prior to admission to the hospital. Before this injury, he had been examined fluoroscopically for possible duodenal ulcer, and the stomach and duodenum were in normal positions. Following an automobile accident, he had bouts of epigastric distress and vomiting which were interpreted as duodenitis for a period of years, and had what later seemed to be strangulation of a hernia through the esophageal hiatus. This patient had a complete obstruction, and after proper preliminary measures, was prepared for surgery. A large strangulated hernia was found, and it was the belief of the operator that the esophageal hiatus had been injured at the time of the automobile accident.

This paper has been so complete that very little could be added. Dr. Carter and his associates have described virtually all the important data associated with traumatic diaphragmatic hernia. I think this paper has been well planned, well organized, and well presented.

DR. CARTER (closing). I think Dr. Barrett has raised a very interesting question regarding hiatus hernia. I am unable to answer his question as to how frequently it does occur. I think the case that he presented would give evidence that this must happen occasionally. As to the location in the diaphragm where the rent most commonly occurs following compression injuries, it has been our experience that it has occurred anteriorly more than posteriorly.

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FLOATING GALLBLADDER STONES

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VARIOUS authors since 1928 have advocated the use of the upright position in gallbladder examinations; namely, Sandström[8] and Åkerlund[1,2,3] of Sweden, Bernstein[4,5] and Eliasz[6] of Germany, and Ettinger,[7] Spillman,[9] and Taylor[10] of the United States.

The purpose of this paper is to re-emphasize the value of the upright position in gallbladder examinations as an additional study to the routine examination.

The technique is essentially the same as for the routine gallbladder examination except that the patient is placed in an upright position. If the gallbladder is obscured by gas in the large or small intestine, roentgenoscopic examination is very helpful in obtaining the best position.

Our routine has been as follows: The oral dye (one tablet of priodax to 15 pounds of body weight, not more than twelve tablets) is given the night before the examination. A film is taken at 8:00 A.M. and another at 11:00 A.M., and the third one at 2:00 P.M., with a fatty meal given at noon. Either the 8:00 A.M. or the 11:00 A.M. examination is made in the upright position, usually the 11:00 A.M. If the upright view does not show the gallbladder as well as the prone films do, then another prone film is taken at the same time.

There are no major disadvantages to the upright film of the gallbladder. If it is desired to conserve film, the upright view may take the place of one of the routine films. Of course, it does take slightly longer.

The following advantages are presented:

1. Most roentgen departments give routine preparation to gallbladder patients before study, but in spite of this there still remains the occasional case with some gas overlying the gallbladder. This situation requires precise posturing in order to throw the gallbladder clear of the superimposing shadows. The erect position may allow the colon to drop below the region of the gallbladder, leaving that area clear for inspection.

2. Many times the roentgenologist is unable to demonstrate small stones in patients who have had typical attacks of gallbladder colic, and in whom surgery demonstrates numerous small stones. These fine stones may not alter the density of the dye in the supine position; however, if the patient is placed in an upright position they will gravitate to the bottom and will more readily become visible.

3. Often it is instructive to know whether calcified stones are freely movable or are impacted within the gallbladder. If movable, they will change position if examined in the prone and afterward in the upright position. If the stone does not move, one can then assume that it is impacted.

4. If calculi are present they will usually gravitate to the fundus, thereby eliminating any doubt as to whether a negative or positive shadow lies within or without the gallbladder.

5. Floating stones, small transparent stones floating within the bile at various levels, present not too rare a condition. These stones may not be visible in the supine position, but will layer out if the upright position of the patient is assumed. There is considerable discussion about the phenomenon of "floating stones," the main issue being whether the floating stones are due to the artificial conditions of cholecystography, namely the presence of dye, or whether small cholesterin stones can float in concentrated native bile. Åkerlund[1,2,3] determined the specific gravity of bile of varying concentrations, examining the

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FIG. 1. Case 1. Oral cholecystogram fourteen hours (8:00 A.M.) following the ingestion of six priodax tablets, showing fairly good concentration of the dye, but with overlying gas. Questionable negative stones.

FIG. 3. Case 1. Same case twenty hours following ingestion of dye (2:00 P.M.), two hours after fatty meal, showing good dye concentration and some contraction of the gallbladder in size. No definite stones are demonstrated, but there are still some shadows which were interpreted as being gas in the small intestine overlying the gallbladder.

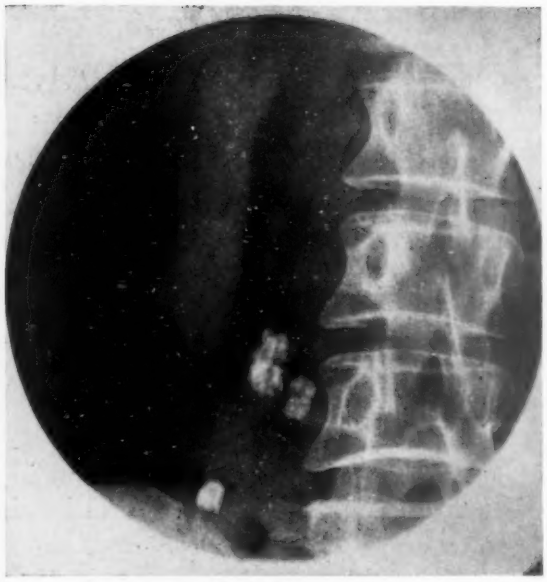

FIG. 2. Case 1. Same case seventeen hours following ingestion of dye (11:00 A.M.), showing normal concentration and questionable evidence of stone.

FIG. 4. Case 1. A film taken in the upright position showing good concentration of the dye, but a layer of decreased density lying transversely within the gallbladder shadow. These proved to be floating stones.

Fig. 5. Case 1. A film taken in the right lateral decubitus position showing a definite layer of stones floating longitudinally in the gallbladder shadow.

stones before they were dried by air. The specific gravity of even the smallest and lightest cholesterin stones was 1.040. This is the greatest specific gravity that native bile ever reaches. Therefore he concludes that stones could hardly float in native bile unless the addition of gallbladder dye increases its specific gravity. We present 2 cases illustrating the phenomenon of "floating stones."

Fig. 6. Case 11. A film taken in the routine prone position revealing the presence of stones within the gallbladder shadow.

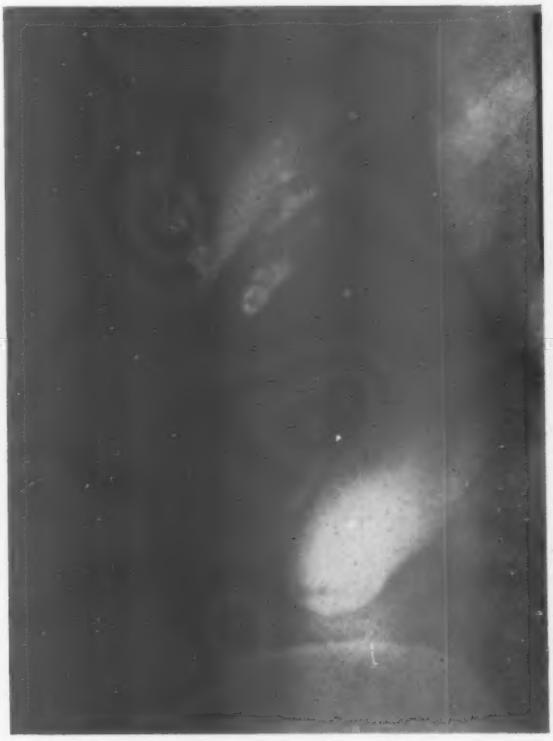

Fig. 7. Case 11. A film taken in the upright position showing a definite floating layer of stones lying transversely within the gallbladder shadow.

CASE I. The first case, that of a woman, clinically presented a history and findings indicative of chronic cholecystitis. Cholecystography by means of the oral dye test on September 13, revealed a normal functioning gallbladder with questionable evidence of stones (Fig. 1, 2 and 3). However, because of the presence of a few overlying, indistinct shadows re-examination was made. This time an upright film was taken which revealed a definite floating layer of stones (Fig. 4) floating transversely within the gallbladder. The patient was then placed on her right side, and another film taken (right lateral decubitus) which revealed a layer of stones floating longitudinally (Fig. 5) in the gallbladder. This proved the presence of floating stones.

CASE II. This second case demonstrates negative gallbladder stones (Fig. 6) very clearly on the routine prone gallbladder film; but the upright film shows floating stones (Fig. 7). We include this case merely as another demonstration of floating stones.

SUMMARY

The frequency with which floating stones occurs is not known. Since, however, an upright film of the gallbladder occasionally shows gallbladder stones that might otherwise be missed, we believe that such a film should be included as a part of every gallbladder study.

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THE ROENTGEN DIAGNOSIS OF UPPER ABDOMINAL RETROPERITONEAL SPACE-OCCUPYING LESIONS*†

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ATTEMPTS at roentgen demonstration of tumefactive lesions of the upper abdominal and retroperitoneal structures utilizing routine methods of study are frequently unproductive of definitive information. The need for a simple method of assaying the width of the retrogastric midline and paravertebral soft tissues and the distribution of the upper abdominal viscera is made manifest after a thorough investigation by means of routine gastrointestinal studies and urographic visualizations fails to demonstrate the presence of lesions which are clinically evident to abdominal palpation.

This concept is valid even when the method of Engel and Lysholm for gastric pneumography is employed since no absolute criteria for linear measurements are available and the usual postulate that "the retrogastric soft tissues are equivalent to the thickness of the anteroposterior diameter of the lumbar body at any level measured" may be considerably altered by obesity, ascites and degree of gastric filling. In addition, it is clear that utilization of such a method of translateral roentgenographic study using either air or barium as contrast material, either in the prone or supine position, presents a limitation in that only the midline retrogastric thickness at the level where the stomach crosses the spine is approximated and no significant data are made available as to the alterations in thickness of the tissues in the epigastric area immediately above or in either paravertebral gutter. Supine translateral abdominal studies with the stomach filled with barium usually demonstrate considerable air content elevating the anterior gastric wall, probably producing artificial anterior displacement of stomach and precluding accurate estimates of postgastric tissue thickness. There are also instances when the major portion of the stomach lies to the left of the midline so that no estimate of midline on right paravertebral tissue thickness is possible.

These deficiencies create a need for a method of adequately exploring the epigastric and postgastric structures on both sides of the midsagittal plane as well as in the midline. Of particular interest is the study of the high midline retroperitoneal space previously a completely silent area in the roentgenographic sense.

An attempt was made to utilize the normal mobility of the barium-filled stomach with change in body position to evaluate alterations in volume of the epigastric, retrogastric and retroperitoneal structures. The procedure followed was routine roentgenoscopic and roentgenographic examination followed by roentgenographic exposures in translateral abdominal right to left supine position as well as both true lateral upright projections, after at least 8 ounces of barium mixture was contained in the stomach. A series of known normals was first so investigated to establish standards of mensuration and configuration. The transabdominal lateral study was quickly discarded since its value proved quite limited and its interpretation frequently led to erroneous concepts.

The left lateral upright projection was found to be quite helpful in demonstrating lesions of the left upper abdominal quad-

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† Published with permission of the Chief Medical Director, Department of Medicine and Surgery, Veterans Administration, who assumes no responsibility for the opinions expressed or the conclusions drawn by the authors.
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rant and the soft tissues of the corresponding retrogastric space. This position was found to yield a true anatomic representation of the stomach in the upright position and its relationship to surrounding viscera. It demonstrated best the displacement and distortion of the stomach produced by splenomegaly, tumors of left kidney, body and tail of pancreas and retroperitoneal masses which extended to the left of the midline. It proved to be of limited value in midline lesions, epigastric lesions and of no value in right paravertebral space-occupying masses.

The right lateral upright study was abandoned since with the major portion of the opacified stomach to the left of the midline a large projectional distortion factor was introduced, particularly when small variations from the true lateral projection were encountered. It was of no great value in lesions of the left paravertebral structures and failed to demonstrate adequately right-sided lesions and lesions of the upper midline space. It was for these reasons that studies were undertaken to determine the range of mobility of the normal barium opacified stomach with alterations of position.

Trial exposures were made in the prone position posteroanterior projection and followed immediately by posteroanterior projections in the left and right lateral recumbent positions. Regardless of the habitus of the patient, it was discovered that in the left lateral recumbent position, there was definite shift of the cardiac end of the stomach to the left and relative fixation of the retroperitoneal portion of the duodenal loop allowing only slight shift to the left of the major portion of the pars media. Posteroanterior projections in the right lateral recumbent position demonstrated moderate mobility (5–7 cm.) of the

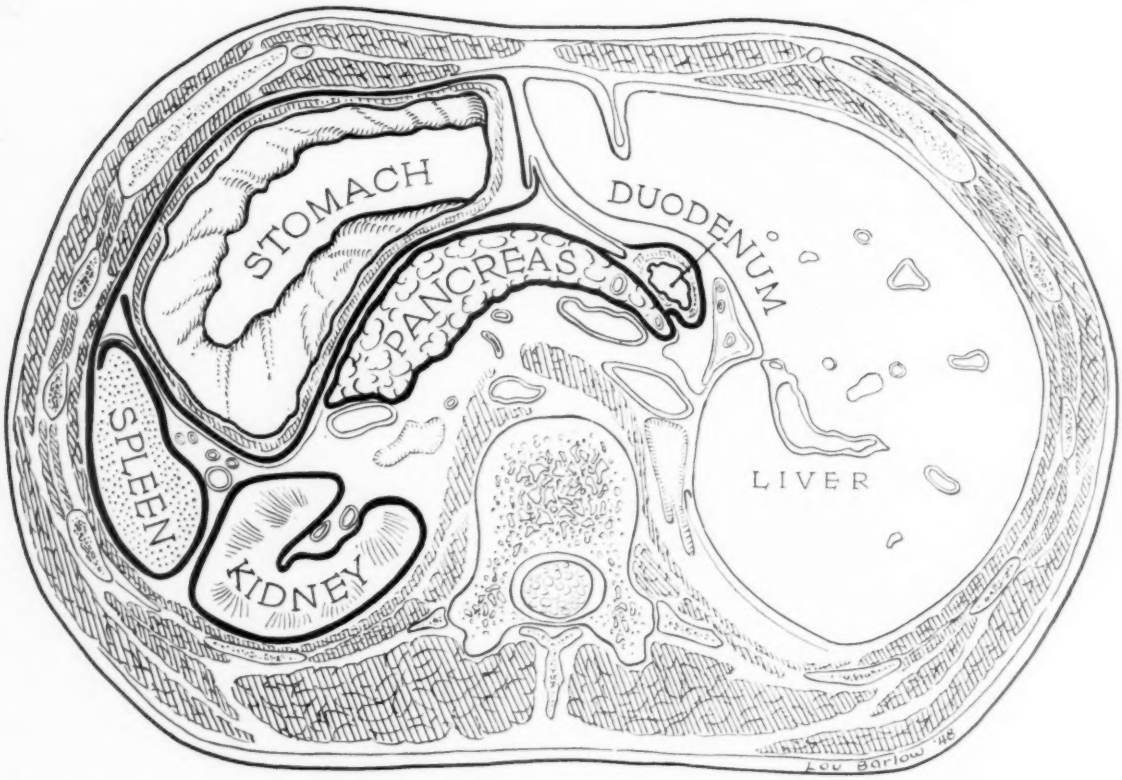

FIG. 1. Cross section (diagrammatic) indicating the disposition of the viscera at the level of L1, indicating the relationship of the pars media of stomach and duodenum to pancreas, spleen, kidney and liver.

cardia and upper pars media portions of the stomach to the right so that they approximated the midline and thus provided a possible avenue of access to the structures of the high midepigastric space not possible by means of any other approach. There was shown to be marked mobility of the pars media and slightly less shift of the antrum. These portions of the stomach were now well to the right of the midline and, for that reason, tumefactions of the midline epigastric area and right paravertebral regions were clearly demonstrated. The duodenal loop, however, remained relatively fixed, except for an occasional instance where, with slight displacement of the duodenal loop, the right kidney was noted to indent the posterior and lateral aspects of the descending duodenum.

Preliminary inspection of the roentgenograms so produced readily demonstrated that no one set of criteria could be established to adequately include all patients. Variations in configuration and position of the opacified stomach were marked so that an attempt at classification seemed desirable. Patients were divided into groups depending on their height, weight, and general body configuration and their roentgen studies were similarly grouped. The normal material was thus divided into three groups: hyposthenic, sthenic, and hypersthenic.

Establishment of a normal was essential to further progress of the study and in order to ascertain the normal retrogastric measurements in left upright and right lateral recumbent, 200 normal patients of various habitus were roentgenographed. The normal, however, varied with each type of habitus necessitating separate concepts of configuration and mensuration.

Analysis of the roentgenograms was productive of the following basic concepts:

Hyposthenic Habitus: The left lateral upright position disclosed the cardiac portion of the stomach in the paravertebral gutter and the linear distance between the anterior vertebral margin and the posterior cardiac gastric wall measured between 0 and 2 cm. The linear measure at the levels of the mid pars media to the postgastric wall fell between 2 and 4 cm. At the plane of the antrum, the postgastric wall lay between 2 and 5 cm. anterior to the anterior vertebral margin. The general configuration for the hyposthenic individual's stomach was direct descent from a far posteriorly situated cardia to a pars media and antrum which closely paralleled the anterior aspect of the vertebral column. In the right lateral recumbent position, the cardia swung slightly anteriorly and in our normals lay between 3 and 4 cm. anterior to the spine. The mid pars media migrated well forward and to the right as evidenced by our measured normals of 4 to 7 cm. The antrum proved to be relatively fixed and its posterior wall lay between 2 and 3 cm. anterior to the vertebral bodies. In this projection the duodenal bulb and descending duodenum were best visualized and their posterior walls overlapped the spine between 1.5 and 3 cm. The duodenal sweep was visualized in its entirety and was shown to be a smooth unbroken curve. This projection we found best demonstrated postérior wall lesions of both the stomach and duodenal bulb, frequently not clearly demonstrated with posteroanterior and oblique studies (Fig. 2).

Sthenic Habitus: Left lateral upright studies with individuals of sthenic habitus demonstrated the cardia of the stomach in the left paravertebral gutter usually overlying the vertebral bodies. The mid pars media was found between 3 and 5 cm. anterior to the spine. The antrum lay between 3.5 and 7 cm. anterior to the vertebral margins. The general configuration of the stomach followed the hyposthenics except that from a posteriorly situated cardia the stomach acquired a slight forward tilt. The more inferiorly situated segments were situated more anteriorly with respect to the spine as a reference point. The postgastric wall was a smooth unbroken slightly convex curve. In right lateral recumbent position the cardia slid forward and to the

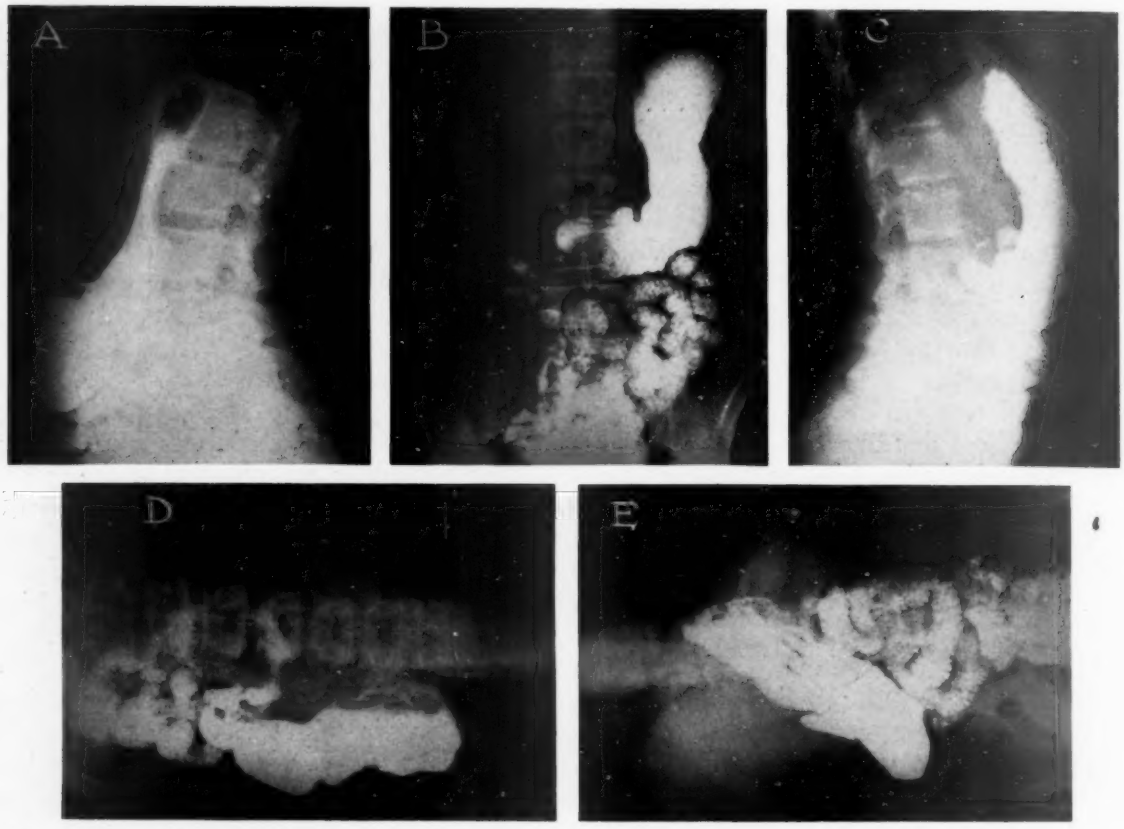

FIG. 2. Normal hyposthenic habitus.

(*A*) Left lateral upright roentgenogram demonstrates close approximation of the posterior gastric surface to the plane of the vertebrae from fundus to antrum.

(*B*) Routine posteroanterior projection, prone position, demonstrates normal relationship of the antrum and bulb to the lumbar vertebrae.

(*C*) Right lateral recumbent position. Note slight anterior migration of the fundus and smooth contour of the posterior gastric wall. Duodenal bulb and sweep overlie the lateral margins of the vertebrae.

(*D*) Posteroanterior projection in the left lateral recumbent position to show the degree of mobility of the pars media, antrum and duodenal bulb.

(*E*) Posteroanterior projection in the right lateral recumbent position clearly indicates the considerable mobility of the fundus, cardia, pars media and antrum to the right.

right so that the distance between postgastric cardia and spine fell between 0–3 cm. anterior to the spine. The mid pars media fell between 6 and 8 cm. anterior to the spine, indicating some anterior migration of the barium-filled stomach as well as a definite swing to the right. The antrum again proved relatively fixed with a distance of 3 to 4 cm. from its posterior wall to the vertebral bodies. The duodenal cap and sweep varied from a 2 cm. spine overlap to a position 2 cm. anterior to the spinal bodies (Fig. 3).

Hypersthenic Habitus: For individuals of hypersthenic habitus the left lateral upright studies demonstrate the posterior cardiac end of this viscus approximating the vertebral column or lying at a maximum of 2 cm. forward of the anterior vertebral margin at the same level. The mid pars media was found between 5 and 10 cm. anterior to the forward vertebral margin depending on the degree of hypersthenia.

The antrum was found to be between 6 and 10 cm. anterior to the vertebrae. The configuration of the barium-filled stomach was that of a rather deeply posteriorly situated pars cardiaca with gradual forward

inclination as the more inferiorly situated distal gastric segments were reached. The duodenal bulb in this type of individual was frequently not superimposed on the antrum of the stomach. With alteration in position to the right lateral recumbent, the cardia slid forward a minimum of almost 2 cm. so that the range of normal distance from the anterior vertebral margin to the posterior wall of the cardia fell between 1 and 5 cm. The mid pars media was quite mobile for most individuals so that the limits of measurement fell between 7 and 14 cm. The antrum proved to be of limited mobility so that mensuration in this projection now yielded figures of 5 to 8 (or 10) cm. from anterior vertebral margin to posterior antral wall. The duodenal cap and sweep in this body type occupied a position usually well anterior to the anterior vertebral margin, though in an occasional instance the posterior descending duodenal wall lay at a plane corresponding to the anterior surface of the vertebral bodies. The

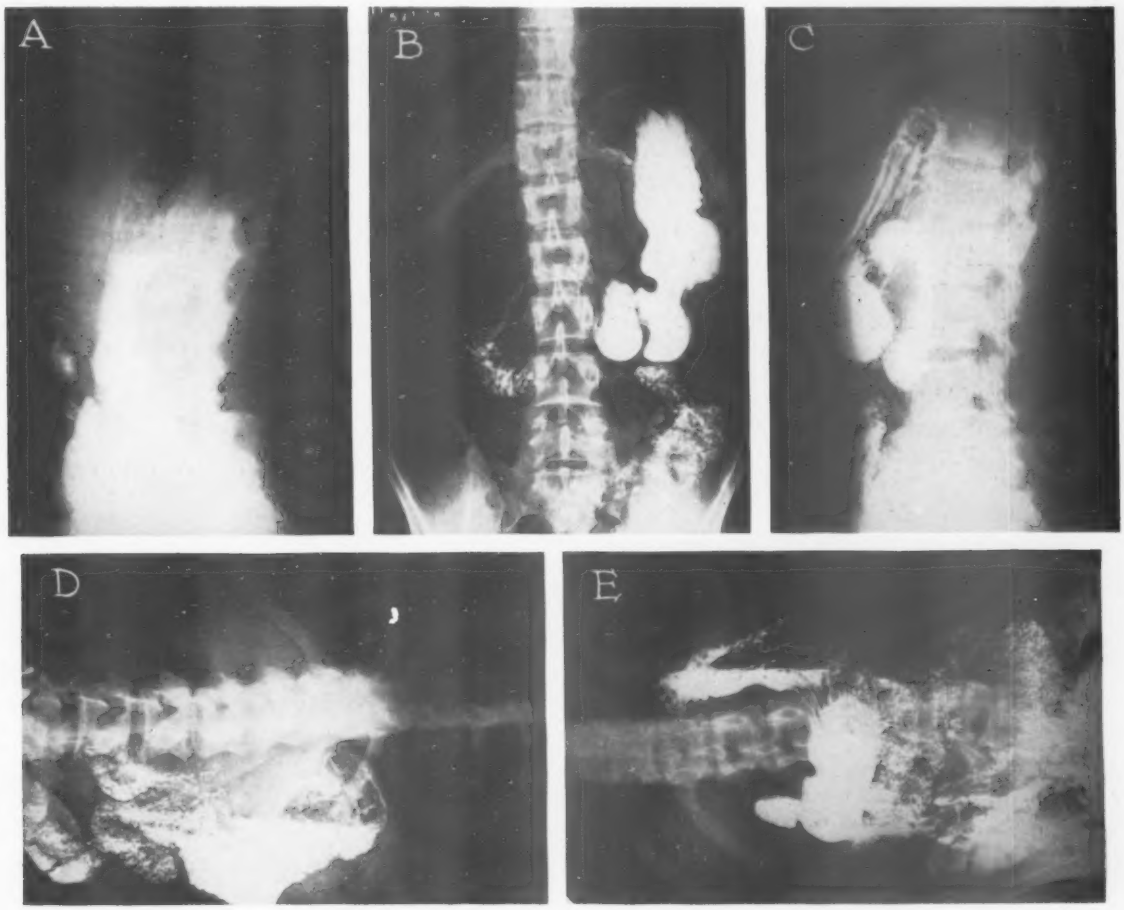

Fig. 3. Normal sthenic habitus.

(*A*) Left lateral upright position—essentially the same configuration observed in hyposthenic individuals.

(*B*) Posteroanterior prone projection to demonstrate the relationship of the antrum and bulb to the vertebrae.

(*C*) Right lateral recumbent position—slight anterior migration of the antrum and pars media. The duodenal bulb and sweep are in close relationship to the plane of anterior vertebral margins.

(*D*) Posteroanterior projection in the left lateral recumbent position. The cardia and fundal segments are less mobile than the pars media, antrum and bulb.

(*E*) Posteroanterior projection in the right lateral recumbent position. There is moderate mobility of the fundus, pars media and antrum to the right.

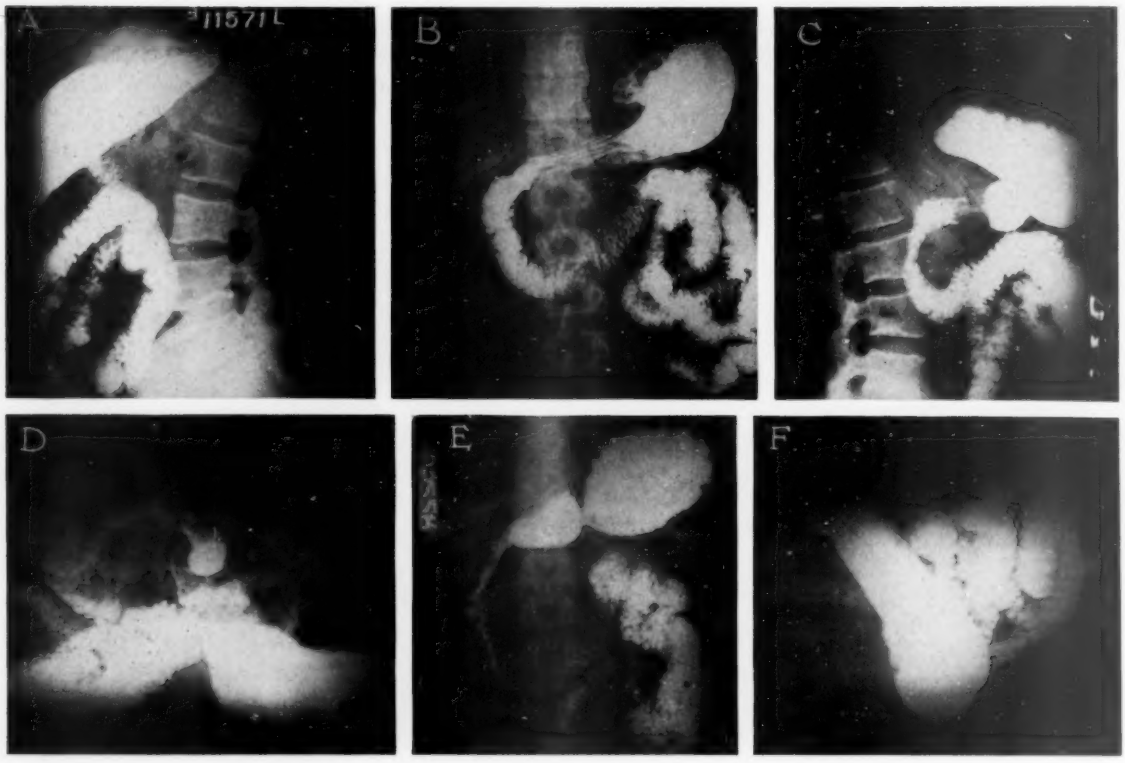

FIG. 4. Normal hypersthenic habitus.

(*A*) Left lateral upright position—anterior inclination of the plane of the stomach and relative anterior position of the pars media and antrum as compared with the fundus.

(*B*) Routine posteroanterior projection to demonstrate relationship of the stomach and bulb with respect to the spine as a reference plane.

(*C*) Right lateral recumbent position which indicates the anterior position of the pars media, antrum and duodenal bulb with respect to the plane of the anterior vertebral margins.

(*D*) Posteroanterior projection in the left lateral recumbent position indicates restricted mobility of the stomach and bulb to the left.

(*E*) Posteroanterior projection in the right lateral recumbent position which indicates slight mobility of the fundus and extreme mobility of the pars media and antrum to the right.

TABLE I

REPRESENTATIVE LINEAR MEASUREMENTS IN CENTIMETERS FROM THE POSTERIOR SURFACE OF THE STOMACH TO THE ANTERIOR VERTEBRAL SURFACE AT LEVELS INDICATED

Height	Weight	Normal Hyposthenic		Right Lateral Recumbent	
		Cardia	Mid pars media	Antrum	Duodenum
5′ 11″	150	3.5 cm.	7 cm.	2 cm.	2 cm. overlap
5′ 9″	145	3 cm.	4.5 cm.	3 cm.	1.5 cm. overlap
5′ 10″	130	4 cm.	6 cm.	2.5 cm.	Contact
5′ 11″	150	3 cm.	6.5 cm.	3 cm.	2 cm. overlap
5′ 11″	145	2 cm.	4 cm.	3 cm.	3 cm. overlap
5′ 10″	150	3 cm.	5.5 cm.	2 cm.	2 cm. overlap
Average		3.5 cm.	5.5 cm.	2.5 cm.	1.5 cm. overlap

configuration of the stomach was such that from a moderately anteriorly situated cardia, the pars media inclined well forward. The antrum then reversed itself so that it lay posterior to the plane of the bodies and the midsagittal plane can a true lateral linear measurement be made.

Nevertheless, this inherent defect does not militate against establishment of aver-

Table II

REPRESENTATIVE LINEAR MEASUREMENTS IN CENTIMETERS FROM THE POSTERIOR SURFACE OF THE STOMACH TO THE ANTERIOR VERTEBRAL SURFACE AT LEVELS INDICATED

Height	Weight	Normal Hyposthenic		Left Lateral Upright
		Cardia	Mid pars media	Antrum
5′ 11″	150	1 cm.	4 cm.	4 cm.
5′ 9″	145	0 cm.	2.5 cm.	4 cm.
5′ 10″	130	2 cm.	3 cm.	5 cm.
5′ 11″	150	1 cm.	3.5 cm.	5 cm.
5′ 11″	145	0 cm.	3.5 cm.	5 cm.
5′ 10″	150	0 cm.	2 cm.	2 cm.
Average		0.5 cm.	3 cm.	4 cm.

Table IV

REPRESENTATIVE LINEAR MEASUREMENTS IN CENTIMETERS FROM THE POSTERIOR SURFACE OF THE STOMACH TO THE ANTERIOR VERTEBRAL SURFACE AT LEVELS INDICATED

Height	Weight	Normal Sthenic		Left Lateral Upright
		Cardia	Mid pars media	Antrum
5′ 8″	170	0 cm.	4 cm.	6 cm.
5′ 8″	155	1.5 cm.	4 cm.	5 cm.
5′ 10″	165	0 cm.	3.5 cm.	3.5 cm.
5′ 5″	150	0 cm.	4 cm.	6 cm.
5′ 6″	150	0 cm.	5 cm.	7 cm.
5′ 6″	150	0 cm.	3 cm.	4 cm.
Average		0–0.5 cm.	4 cm	5 cm.

Table III

REPRESENTATIVE LINEAR MEASUREMENTS IN CENTIMETERS FROM THE POSTERIOR SURFACE OF THE STOMACH TO THE ANTERIOR VERTEBRAL SURFACE AT LEVELS INDICATED

Height	Weight	Normal Sthenic		Right Lateral Recumbent	
		Cardia	Mid pars media	Antrum	Duodenum
5′ 8″	170	0 cm.	8 cm.	4 cm.	1 cm. overlap
5′ 8″	155	2.5 cm.	6 cm.	4 cm.	2 cm. overlap
5′ 10″	165	3 cm.	6.5 cm.	3.5 cm.	1.5 cm. overlap
5′ 5″	150	3 cm.	7 cm.	3 cm.	2 cm. overlap
5′ 6″	150	1 cm.	6.5 cm.	4 cm.	Contact
5′ 6″	150	0 cm.	6 cm.	4 cm.	Contact
Average		1.5 cm.	6.5 cm.	3.75 cm.	1 cm. overlap

pars media and the duodenal bulb and sweep are thrown into bold lateral relief usually lying well anterior to the vertebral column (Fig. 4).

The measurements which were obtained, we fully realize, in some instances represent oblique, foreshortened linear distances, since only for those segments of the stomach which are directly anterior to the vertebral age normal measurements and their utilization in the analysis of the abnormal, in instances of space-occupying retrogastric lesions.

The tables and case reports which follow are representative of the normals and indicate the manner of application of these normal values in the interpretation of variations produced by disease.

TABLE V

REPRESENTATIVE LINEAR MEASUREMENTS IN CENTIMETERS FROM THE POSTERIOR SURFACE OF THE STOMACH TO THE ANTERIOR VERTEBRAL SURFACE AT LEVELS INDICATED

Height	Weight	Normal Hypersthenic		Right Lateral Recumbent	
		Cardia	Mid pars media	Antrum	Duodenum
5′ 7″	175	2.5 cm.	7 cm.	5 cm.	2.5 cm.
5′ 11″	192	0–1 cm.	7 cm.	10 cm.	2.5 cm.
5′ 5″	205	3 cm.	7 cm.	5 cm.	1.5 cm.
5′ 6″	180	1 cm.	8 cm.	8 cm.	3 cm.
5′ 11″	200	4 cm.	9 cm.	8 cm.	Contact
5′ 8″	190	5 cm.	14 cm.	10 cm.	4 cm.
Average		2.5 cm.	8.5 cm.	7.5 cm.	2 cm.

TABLE VI

REPRESENTATIVE LINEAR MEASUREMENTS IN CENTIMETERS FROM THE POSTERIOR SURFACE OF THE STOMACH TO THE ANTERIOR VERTEBRAL SURFACE AT LEVELS INDICATED

Height	Weight	Normal Hypersthenic		Left Lateral Upright
		Cardia	Mid pars media	Antrum
5′ 7″	175	0 cm.	6.5 cm.	7 cm.
5′ 11″	192	0 cm.	5 cm.	8 cm.
5′ 5″	205	0 cm.	10 cm.	6.5 cm.
5′ 6″	180	0 cm.	9.5 cm.	9 cm.
5′ 11″	200	0 cm.	5 cm.	10.5 cm.
5′ 8″	190	2 cm.	9 cm.	10 cm.
Average		0.5 cm.	7.5 cm.	8.5 cm.

CASE REPORTS

CASE 1. *Hyposthenic Habitus.*

A white male, aged fifty-two, admitted to the hospital because of pain in the right upper abdomen and anorexia. He had had no jaundice. Physical examination disclosed a chronically ill appearing white male with marked muscle spasm in the right upper abdomen, tenderness to pressure and a sense of a deep mass. Liver function tests as well as the remaining laboratory studies were negative. Gastrointestinal examination disclosed the presence of a pancreatic mass (Fig. 5, *A–C*).

Posteroanterior and oblique projections of the opacified stomach were entirely normal. There was no suggestion of retrogastric mass.

Right lateral recumbent study revealed anterior displacement of the mid pars media of the stomach with alteration in the configuration of

FIG. 5. (*A*) (*B*) (*C*) Case 1. Hyposthenic habitus. (*A*) Note marked anterior displacement of pars media and antrum when contrasted with the normal (Fig. 2*A*). (*B*) Routine posteroanterior projection relatively normal. Oblique study uninformative. (*C*) Right lateral recumbent position discloses pressure indenture and anterior displacement of the antrum and pars media, produced by a malignancy of the body of the pancreas with metastic nodes in the right paravertebral region.

(*D*) (*E*) Case II. Sthenic habitus. (*D*) Left lateral upright position demonstrates marked anterior displacement of the antrum and a pressure indenture of the pars media posteriorly indicating involvement of the tail of the pancreas as well as the body. (*E*) Marked pressure indenture along the posterior aspect of the pars media produced by a tumor of the body of the pancreas.

(*F*) (*G*) (*H*) Case III. Sthenic habitus. (*F*) Left lateral upright position. Multiple indentures posterior stomach wall and anterior displacement of the antrum and pars media. (*G*) Incomplete filling of the pars media produced by pressure from a neighboring mass of indeterminate site. (*H*) Marked displacement of the pars media and antrum in an anterior direction shown in right lateral recumbent projection.

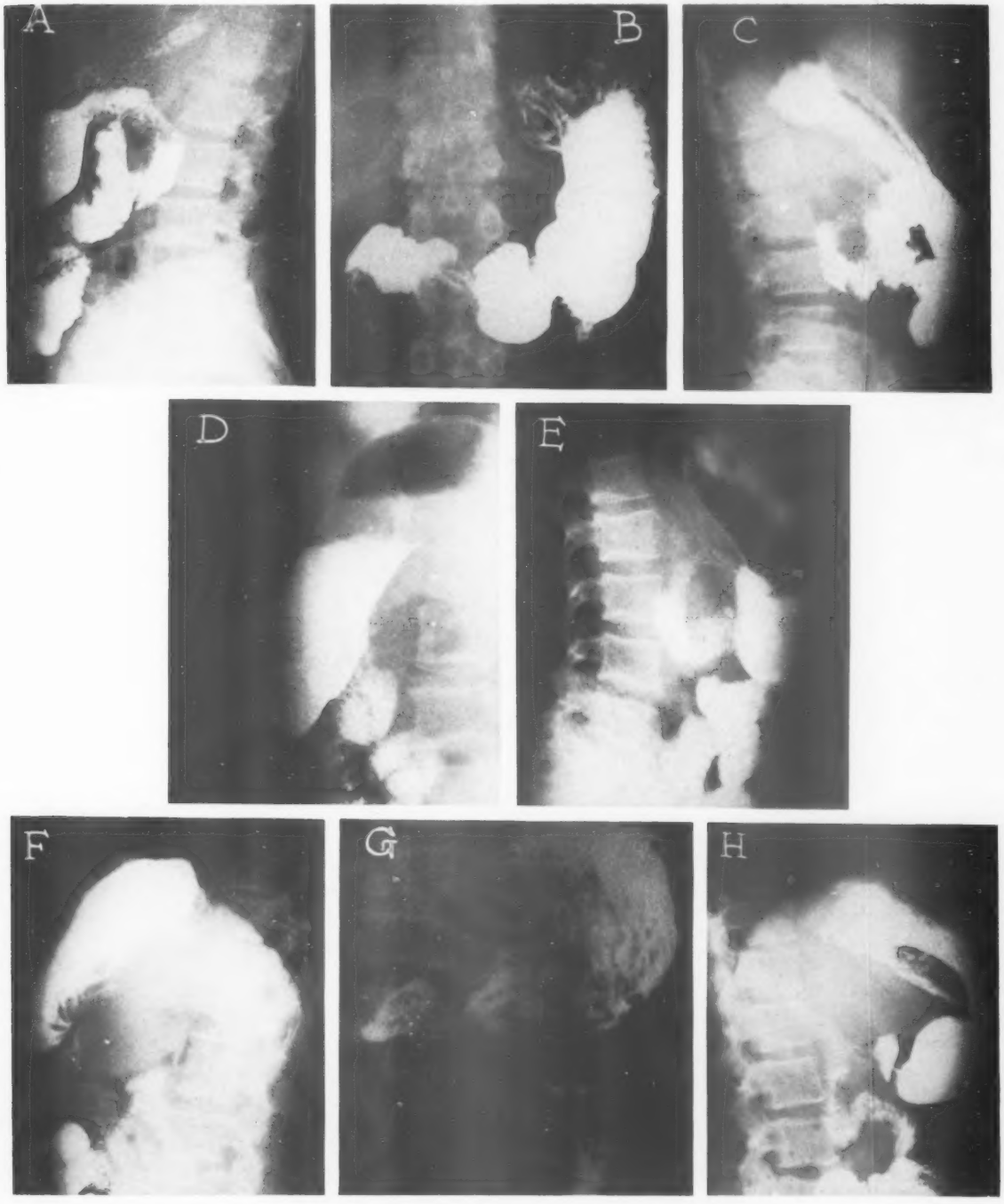

Fig. 5

the posterior gastric wall. The duodenal bulb was displaced anteriorly and the superior duodenal angle depressed. Normal hyposthenic linear measurements at the levels of the cardia, mid pars media, antrum and duodenum are 3.5, 5.5, 2.5 cm. and usually spine overlap by the duodenal bulb. In this instance the linear measurements at corresponding levels were 0, 6.5, 10.5 cm. and contact. The indications were then clear for a retrogastric mass displacing the mid pars media and antral segments of the stomach and duodenum. The lesion was placed in the pancreatic body with lesser involvement of the head.

Left lateral upright study was informative since it disclosed marked distortion of the position and configuration of the gastric segments. The midportion of the stomach was markedly displaced anteriorly, permitting visualization of the duodenal bulb in profile behind the posterior gastric wall. Normal measurements at the cardia, mid pars media and antrum for hyposthenic individuals are 0.5, 3 and 4 cm., respectively. This left lateral upright study measured 0, 7 and 8 cm. for similar levels of measurement.

Exploratory laparotomy disclosed a neoplasm of the body of the pancreas with metastatic disease of the liver and regional nodes. The operative diagnosis was corroborated by the postmortem findings.

CASE II. *Sthenic Habitus.*

This white male, aged fifty-six, was admitted for left upper abdominal pain, radiating to the left upper lumbar region and costovertebral angle. He had suffered a 35 pound weight loss, and observation elsewhere disclosed a progressive hepatomegaly. Examination on entry disclosed scleral icterus. The liver edge was palpated at the level of the umbilicus. There was no adenopathy. Icterus index was 20; serum alkaline phosphatase 8.2 and the direct van den Bergh was reported as 2.3 units.

Routine posteroanterior and oblique roentgen studies were singularly uninformative. Definitive diagnosis based solely on these studies was not possible. Examination of the right lateral recumbent films, however, disclosed a suggestive pressure indenture with failure of filling of the posterior segment of the pars media and antrum of the stomach. The duodenal bulb is displaced in an anterior direction, but the limbs of the duodenal curve are not particularly distorted.

Normal measurements in the right lateral recumbent position for sthenic individuals are 1.5, 6.5, 3.5 and 1 cm. for levels of cardia, mid pars media, antrum and duodenum, respectively. Measurements in this instance were 3, 6.5, 9 and 0 cm. for similar planes. The antrum and duodenal bulb are shown to be displaced and betray the presence of a space-occupying mass in the retrogastric region, corresponding to the body of the pancreas.

Left lateral upright projection is useful chiefly in confirming the presence of marked anterior antral displacement, since this segment appears well forward of the major portion of the body of the stomach. In addition, there is apparent a shallow posterior indenture of the mid pars media.

Normal numerical values for sthenic individuals in left lateral upright projection are 0.5, 4 and 5 cm. for the cardia, mid pars media and antrum. This study provided values of 0, 4 and 10 cm. at corresponding levels.

The major deformity and displacement is shown to be antral and places the site of tumefaction within the body of the pancreas. Again, the lateral roentgenograms are productive of definitive diagnostic information where routine studies are deficient (Fig. 5, *D*, *E*).

The patient's icterus progressed rapidly, and after preoperative preparation, exploratory operation disclosed a massive neoplasm of body and tail of the pancreas with involvement of stomach and multiple peritoneal seedings.

CASE III. *Sthenic Habitus.*

A white male, aged forty-one, was admitted to the hospital for irradiation of an upper abdominal tumor declared inoperable by exploratory laparotomy at another institution. His complaints dated back three years when he first noted the onset of upper abdominal pain, frequently accompanied by nausea and vomiting.

Examination on admission to the hospital disclosed a well developed, well nourished male with a vague sense of resistance in the left upper abdomen to the left of a well healed rectus incision. Gastrointestinal examination reported a retrogastric mass in the region of the body and tail of the pancreas. Exploration was advised, and a large cyst of the tail of the pancreas was found. A pancreaticojejunostomy was performed with considerable symptomatic relief.

Right lateral recumbent study demonstrated a marked indenture of the posterior gastric wall, the antral and pars media segments disclosing maximal displacement. The duodenal bulb was not displaced anteriorly, and the duodenal sweep limbs were not encroached upon (Fig. 5, *F–H*).

Normal values for sthenic individuals at the levels of the cardia, mid pars media, antrum and duodenum in the right lateral recumbent position are 1.5, 6.5, 3.5 and 1 cm.

The patient's roentgenograms measured 0, 12.5, 8.5 and 0 cm. for corresponding planes of measurement. The numerical increase in the

retrogastric space then is quite clear and is confined to the antral and midgastric sites.

The left lateral upright projection disclosed several zones of indenture on the postgastric wall with compression of the gastric rugal folds. The cardia is not displaced, but the mid pars media and antral segments are markedly displaced anteriorly. Normal measurements for this type of individual in this projection are 0.5, 4 and 5 cm. for the cardia, mid pars media and antral segments, respectively. Measurements for this patient were 0, 6.5 and 9.5 cm. for corresponding sites.

The indications, therefore, were for a large, non-infiltrating space-occupying lesion of the body and tail of the pancreas with little, if any, involvement of the head and neck. The routine roentgenograms suggested compression on the posterior gastric surface, but it is only after careful examination of right lateral recumbent and left lateral upright studies that a true evaluation of the actual volume of the mass can be attained. The roentgenographic localization and volumetric estimate were confirmed by the exploratory operation. This, we feel, is quite the typical appearance of a cystic lesion of the body and tail of the pancreas.

Case iv. *Sthenic Habitus.*

This patient, a white male, aged forty-six, was admitted with a history of lower abdominal pain and anorexia of six months' duration. On admission, he was noted to be chronically ill, but no definite findings were disclosed on examination, except for mild secondary anemia. Gastrointestinal studies reported a retrogastric mass. Because of continued weight loss and clinical retrogression, exploratory laparotomy was performed, at which time a large, firm, smooth retroperitoneal mass was disclosed. The biopsy reported was Hodgkin's disease.

Complete clinical and laboratory study failed to disclose any evidence of this patient's underlying disease. Routine roentgenographic gastrointestinal examinations in posteroanterior and oblique projections proved of little value. Special studies in the right lateral recumbent and left lateral upright positions clearly demonstrated the presence of retroperitoneal, retrogastric masses, which resulted in the establishment of a working diagnosis, and provided the proper avenue of approach to the clinical problem.

Normal values for sthenic individuals at the levels of the cardia, mid pars media, antrum and duodenum in the right lateral recumbent are 1, 5, 6.5, 3.5 and 1 cm. The patient's roentgenograms measured 7.0, 15.5, 14.5 and 9 cm., respectively. The normal left lateral upright measurements are 0.5, 4 and 5 cm. for the cardia, mid pars media and antrum. The measurements for this patient are 2.5, 10.5 and 10 cm. (Fig. 6, *A–C*).

These variations from the normal values clearly indicated a mass situated in the midline, and extending both to the right and left of the midsagittal plane.

Case v. *Sthenic Habitus.*

This patient a is white male, aged forty-two, who first noted the onset of generalized adenopathy in 1943. A diagnosis of lymphatic leukemia was quickly established, and he was referred to Walter Reed Hospital for radiotherapy. Subsequent to his separation from the service, he received an additional course of therapy at a local institution.

On entry to this hospital, he was noted to display a papular eruption of the chest, upper abdomen and back, as well as considerable splenomegaly. His red blood cell count was 4.5 million and the white blood cell count was 5,500. The skin biopsy disclosed the presence of lymphoblastomatous involvement in the nature either of a lymphosarcoma or chronic lymphatic leukemia.

Previous blood counts as high as 30,000 white blood cells with 60 to 75 per cent lymphocytes had been reported.

Right lateral recumbent roentgen study demonstrated anterior displacement of all segments of the stomach. The superior duodenal angle was depressed, displaced anteriorly, and disclosed an extrinsic pressure indenture superiorly. These findings were not manifest on routine posteroanterior and right anterior oblique projections.

Normal values for sthenic individuals at the levels of the cardia, mid pars media, antrum and duodenum in the right lateral recumbent are 1.5, 6.5, 3.5 and 1 cm. The patient's roentgenograms measured 3.5, 9.5, 8.5 and 5 cm. for corresponding sites of measurement (Fig. 6, *D–F*).

The left lateral upright study disclosed typical gastric deformity and displacement produced by splenomegaly. The cardia is slightly displaced, but the pars media and antrum are markedly displaced in an anterior direction.

Normal left lateral upright measurements are 0.5, 4 and 5 cm. for the cardia, mid pars media and antrum. Measurements in this instance were 2, 9 and 8.5 cm. for the corresponding sites. The linear measurements are well above the established normals for sthenic individuals. The extent of displacement and the configuration of the stomach are well demonstrated and might escape detection in routine gastrointestinal roentgenograms. They indicate moderately marked splenomegaly as well as paraduodenal and retroperitoneal adenopathy.

CASE VI. *Sthenic Habitus.*

In July, 1946, this patient first noted enlargement of his right testicle. A right orchiectomy was performed in December, 1946, and shortly thereafter patient was admitted because of a mass in the epigastrium, productive of malaise and upper abdominal pain. Examination disclosed a 10 by 10 cm. vague epigastric mass. The patient received radiotherapy with moderate symptomatic response, and some reduction in size of the epigastric mass. Biopsy of the testicle disclosed an embryonal carcinoma (Fig. 6, *G–I*).

Right lateral recumbent roentgen studies demonstrated anterior displacement of the antrum and distal pars media segments of the stomach. The limbs of the duodenal sweep were similarly displaced. Examination of the routinely done posteroanterior and oblique projections suggested some distortion of the duodenal curve as well as compression of the valvulae. However, it was not until the right lateral study was examined that the true extent of the deformity was appreciated. Normal values for sthenic individuals at the levels of the cardia, mid pars media, antrum and duodenum in the right lateral recumbent position are 1.5, 6.5, 3.5 and 1 cm., respectively. This patient's roentgenographic measurements were 2.5, 9.5, 9 and 4.5 cm. for corresponding sites of mensuration.

Left lateral upright study suggested a shallow indenture of the postgastric wall, but what was of much greater significance, visualization of the the prepyloric gastric segment and duodenal bulb, well anterior to the midfrontal plane of the stomach. Normal left lateral upright measurement for these individuals are 0.5, 4 and 5 cm. for the cardia, mid pars media and antrum. Measurements in this instance were 0, 3.5 and 5 cm. for corresponding sites.

It is clearly apparent, then, that accurate localization and a true evaluation of the actual sites of metastatic nodal disease is immeasurably aided by the right lateral recumbent and left lateral upright projections. This patient's nodal disease is shown to be paraduodenal, and in the midline retroperitoneal epigastric zones, with little, if any, disease to the left of the midline, corresponding to the left paravertebral gutter.

CASE VII. *Sthenic Habitus.*

This male, aged twenty, was admitted to the hospital because of a right femoral mass of ten months' duration. The previous diagnosis of Hodgkin's disease had been established on the basis of a biopsy of a cervical node, and he had received intensive radiotherapy while in service. Admission was sought because of fever, chills, nausea and vomiting. Examination disclosed multiple lymph node masses in the cervical, supraclavicular and axillary regions. Gastrointestinal examination reported anterior gastric displacement, and nitrogen mustard therapy was instituted with excellent clinical and symptomatic response.

FIG. 6. (*A*) (*B*) (*C*) Case IV. Sthenic habitus. (*A*) Left lateral upright position—note the marked anterior displacement of distal half of the pars media and antrum. (*B*) Routine posteroanterior projection essentially normal. (*C*) Right lateral recumbent position showing remarkable anterior displacement of the stomach and duodenum including descending limb.

(*D*) (*E*) (*F*) Case V. Sthenic habitus. (*D*) Left lateral upright position discloses slight displacement of the cardia, but marked deformity and displacement of the pars media and antrum (splenomegaly). (*E*) Relatively normal appearance of the stomach in posteroanterior projection. (*F*) Right lateral recumbent position—anterior displacement of all segments of the stomach and focal depression and distortion of the postbulbar duodenum produced by periduodenal nodal masses.

(*G*) (*H*) (*I*) Case VI. Sthenic habitus. (*G*) Left lateral upright position—note marked displacement of the antrum and duodenal bulb. There is, in addition, a shallow indenture of the posterior surface of the stomach. (*H*) Routine posteroanterior projection—no obvious gross abnormality. (*I*) Right lateral recumbent position—discloses anterior displacement of the stomach (pars media and antrum) and duodenum.

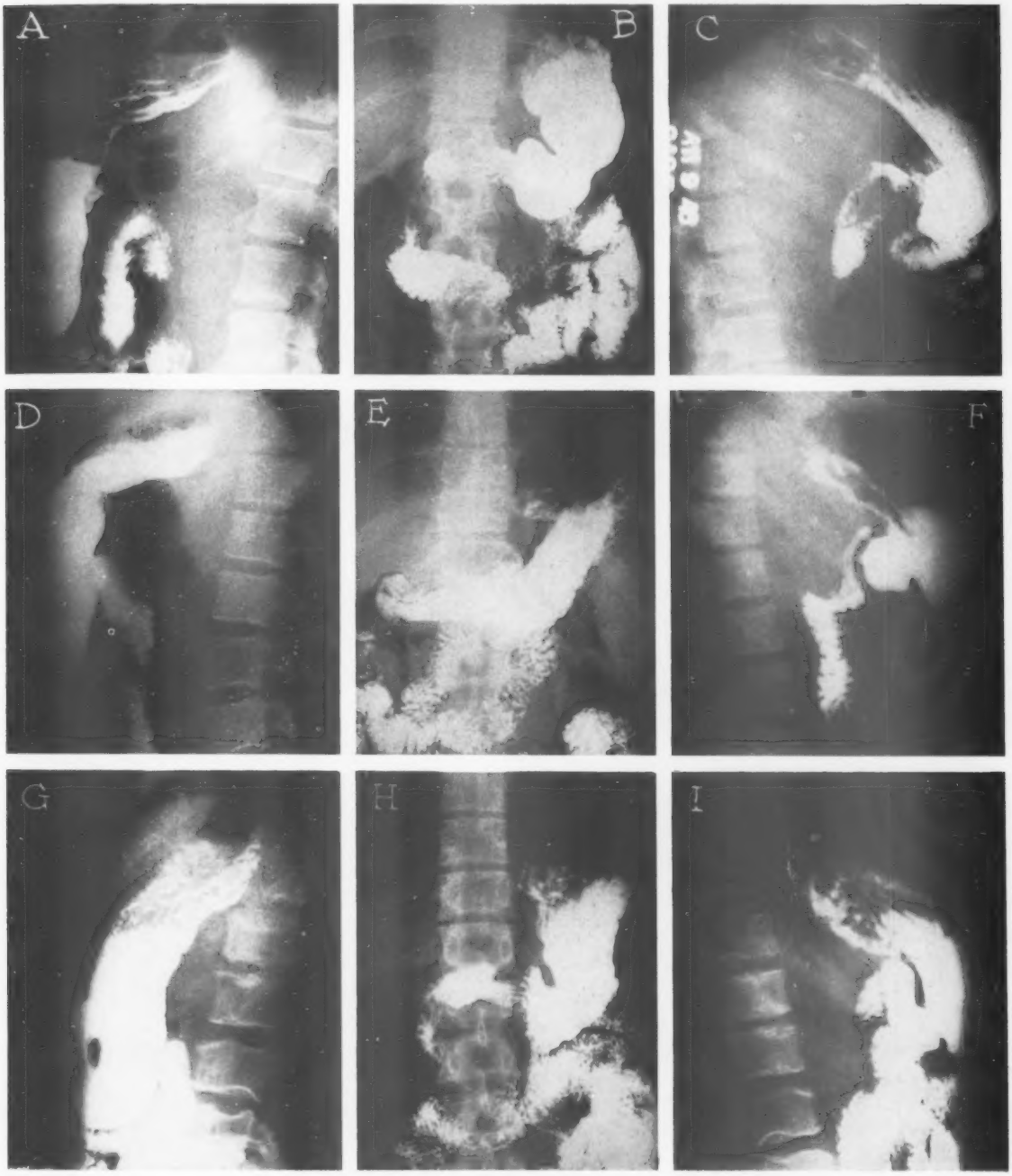

Fig. 6

Routine posteroanterior projection of the opacified stomach suggested a space-occupying lesion in relationship to the antral segment of the stomach. Right lateral recumbent film was clearly indicative of anterior displacement of all segments of the stomach. The duodenal bulb was similarly displaced, the superior duodenal angle depressed, and the proximal descending duodenal segment depressed and displaced forward, in addition to which a posterior pressure indenture was identified (Fig. 7, *A–C.*)

Normal values for sthenic individuals at the levels of the cardia, mid pars media, antrum and duodenum are 1.5, 6.5, 3.5 and 1 cm., re-

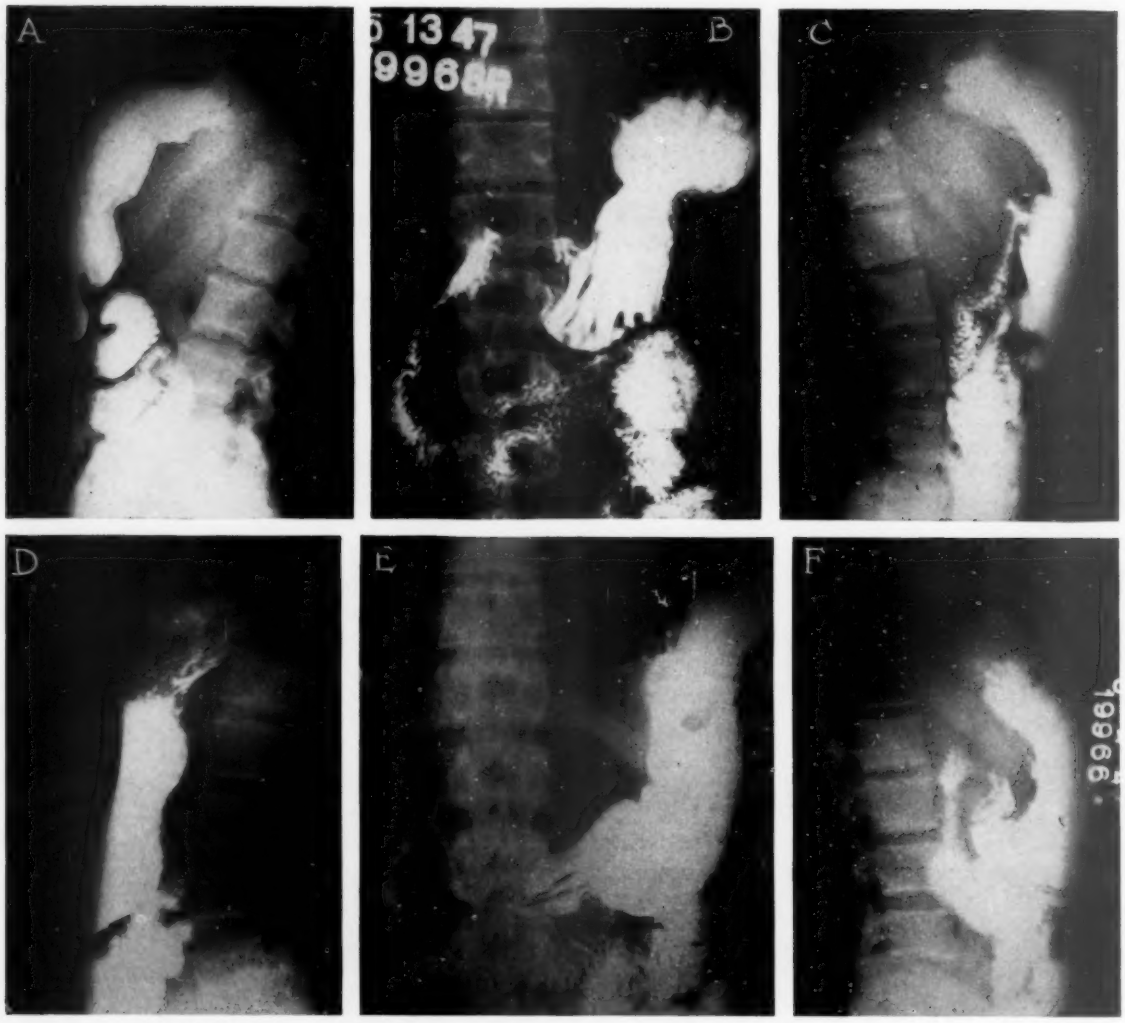

FIG. 7. (*A*) (*B*) (*C*) Case VII. Sthenic habitus. (*A*) Left lateral upright position—anterior displacement of the pars media and antral segments of the stomach with multiple shallow pressure indentures of the posterior gastric surface. (*B*) Routine posteroanterior projection suggests a mass lesion in relationship to the antrum. (*C*) Right lateral recumbent position—note marked displacement of the gastric segments, depression and distortion of the duodenal bulb and descending duodenum.

(*D*) (*E*) (*F*) Case VIII. Hyposthenic habitus. (*D*) Left lateral upright position—multiple gastric posterior wall indentures. Posterior gastric wall approximates the plane of the anterior vertebral margins. (*E*) Normal appearance of the routine posteroanterior projection. (*F*) Right lateral recumbent position—note anterior displacement of the stomach, depression of the superior duodenal angle and anterior displacement of the mid descending duodenum.

spectively, for the right lateral projection. This patient's study measured 4, 10.5, 8 and 7 cm. for similar levels. The gross and uniform anterior displacement is numerically confirmed.

Left lateral upright projection confirmed the supposition of anterior displacement since normal values for this individual should be 0.5, 4 and 5 cm. for measurements at the cardia, mid pars media and antrum, and actually proved to be 2.5, 7.5 and 8 cm. for the levels indicated.

The combined study, therefore, clearly indicated displacement produced by paraduodenal, midline epigastric and left paravertebral nodal disease and provided a more accurate guide to the extent and distribution of disease than the routine posteroanterior projection furnished.

Case viii. *Hyposthenic Habitus.*

This male, aged thirty-one, was transferred to this institution after orchiectomy elsewhere had disclosed an embryonal adenocarcinoma of the left testicle.

Abdominal examination disclosed vague left upper abdominal and epigastric masses. Roentgenographic studies revealed a metastatic left hilar nodal mass, as well as retroperitoneal nodal disease, producing a left hydronephrosis and displacement of the proximal third of the left ureter. Gastrointestinal studies demonstrated space-occupying disease in the retrogastric region producing displacement of the stomach and proximal descending duodenum.

Routine posteroanterior and oblique projections of this patient's stomach and duodenum were not productive of definite diagnostic information. The stomach was not grossly displaced and the limbs of the duodenal sweep were normally distributed (Fig. 7, *D–F*).

Right lateral recumbent studies disclosed some depression of the superior duodenal angle as well as a pressure indenture of the posterior aspect of the descending duodenum. Normal values for hyposthenic individuals at the levels of the cardia, mid pars media, antrum and duodenum are 3.5, 5.5, 2.5 cm. and usually an overlap of the spine. This patient's lateral study measurements were 4.5, 7.5, 6 cm. and contact, respectively, for similar planes. The linear displacement from a numerical standpoint is small, but the configuration and disposition of the segments of the stomach certainly suggest extragastric disease.

Normal left lateral upright measurements for hyposthenics are 0.5, 3 and 4 cm. for the cardia, mid pars media and antrum. This patient's lateral study measurements were 0, 2 and 3 cm. for corresponding levels. It is noteworthy that despite the upper normal limits of measurement, the diagnosis of left paravertebral space-occupying disease can be suggested on the basis of the clearly disclosed polyarcuate posterior wall gastric indentures.

In this connection, it may be stated that on occasion in our cases, accurate diagnoses of space-occupying disease could be made even when the upper limits of mensuration were not exceeded by the appearance of pressure indentures which altered the usual disposition and configuration of the barium-filled stomach and duodenum.

CONCLUSIONS

Two hundred normal barium-filled stomachs were roentgenographed to establish average normal retrogastric measurements in the right lateral recumbent and left lateral upright positions for individuals of hyposthenic, sthenic and hypersthenic habitus.

Roentgenographic studies of the barium-filled stomach in the right lateral recumbent position disclosed extensive mobility of the cardia and pars media and less free mobility of the antrum. This mobility of the gastric segments was utilized to disclose the presence of space-occupying lesions high in the epigastric, midepigastric and paravertebral regions.

The left lateral upright roentgen studies were found to be valuable in demonstrating tumors of the tail of the pancreas and kidney as well as splenic enlargement.

The eight cases presented emphasize the value of establishing average normal retrogastric measurements and stress the importance of the left lateral upright and right lateral recumbent positions in disclosing space-occupying lesions in high epigastric and midepigastric right and left lateral paravertebral regions at the same levels.

The helpful criticisms and suggestions of Dr. Maxwell H. Poppel were an invaluable aid.

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Vol. 65, No. 1

VITAL STAINING WITH THE FLUOROCHROME ACRIDINE ORANGE AND ITS APPLICATION TO RADIOBIOLOGY

I. ALPHA-RAY EFFECTS

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INTRODUCTION

IN 1940, Bukatsch and Haitinger[1] and Strugger[4] introduced the modern fluorochrome acridine orange (Fig. A) for the vital staining of protoplasm. Compared to other techniques, it has the advantages that the protein component of living protoplasm is stained without a noticeable toxic reaction; the dye in dilutions of 1:10,000 or greater has sufficient "optical density" to be detected in the stained cell; in aqueous solutions, the dye exhibits a "concentration effect," i.e., the characteristic fluorescence of the solution depends on the dye concentration. Dilutions approximating 1:10,000 exhibit a green fluorescence whereas dilutions approximating 1:500 have a red color.

The concentration characteristic of the dye has been used extensively to test the viability of tissue, for dead cells take up more dye and fluoresce red, whereas living cells take up less dye and fluoresce green. Using other methods adequate to determine the viability of cells, this difference in fluorescence in life versus death was observed with yeast, *Allium cepa*, *Tradescantia*, milk sediments, spermatozoa and various pathogenic and non-pathogenic bacteria.[5]

In 1944, the acridine orange staining technique was proposed as a method to study damage to cells by radiation.[3] The present report confirms and extends the original preliminary investigations.

EXPERIMENTAL

A. *Apparatus, Methods and Procedures.* The specimens investigated were the epidermis of the onion (*Allium cepa*) and yeast (Fleischmann). The third shell of the onion was used and from it the epidermis was peeled away by the gentle suction technique described by Strugger.[5] The epidermis sections (about 10 mm. square) were then stained in the 1:10,000 dye solutions. The pH was adjusted to within physiological limits and the staining time was ten minutes. After staining, the sections were

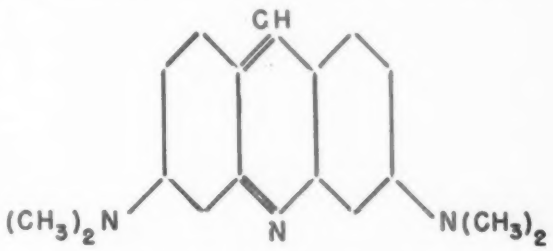

FIG. A. 3,6-tetramethyl-diamino-acridine.

removed and rinsed, placed on a slide, covered with a cover slip and observed under the fluorescence microscope. In working with yeast, fresh preparations were made each time. The yeast cells were stained in 1:5,000 dilutions of slightly alkaline dye. This could be accomplished by taking either a droplet of dye and one of a yeast suspension, or mixing equal parts of dye and yeast solution in a test tube—total dilution of dye about 1:10,000. Staining time was also about ten minutes and the suspension was examined in the same manner as the onion epidermis.

Irradiations were made with alpha particles from polonium.† The polonium was deposited on nickel foils 5 mm. square. The strongest preparation used gave about 10^7 alpha particles/mm.^{2}/min. Irradiation was done in small chambers (see Fig. B), so constructed that the alpha source to specimen distance was about 1 mm. To prevent the condensation of

† Obtained from Eldorado Mining & Refining (1944) Limited, Ottawa, Canada.

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moisture on the Po preparation, a gentle stream of dry air may be blown over it.

The dye used in this work came from two sources. A German (Standardisierter Farbstoff "Bayer", Grübler-Holborn), and an American acridine orange (C.I. 788 National Aniline Division). In spite of the fact that the absorption curves of the two differed slightly, their staining behaviors were similar. The stains were used interchangeably in this investigation.

The equipment used for examination of the stained specimen consisted of a light source with proper blue or ultraviolet filter, an ordinary microscope and an eye protective filter (Fig. C). The light source was either a Leitz self-fed carbon arc used with a Beckman B-2 and B-4 filter combination or else the Spencer 353 fluorescence equipment. The eye protective filter was a Wratten K-3 located in or on the eyepiece. To obtain a dark background, it is important to use the proper filter combination. A glance at the transmission curves of two blue-ultraviolet filters and two K-3 filters will stress immediately this importance (Fig. D). To obtain greater efficiency in ultraviolet reflection, the standard microscope mirror was replaced by an aluminized front surface mirror.

To record the changes going on in the preparation during the irradiation, frequent photomicrographs were taken during and after irradiation. These were made with the aid of the Leitz Micro-Ibso attachment and a 35 mm. Leica housing. Both Ansco color and Koda-

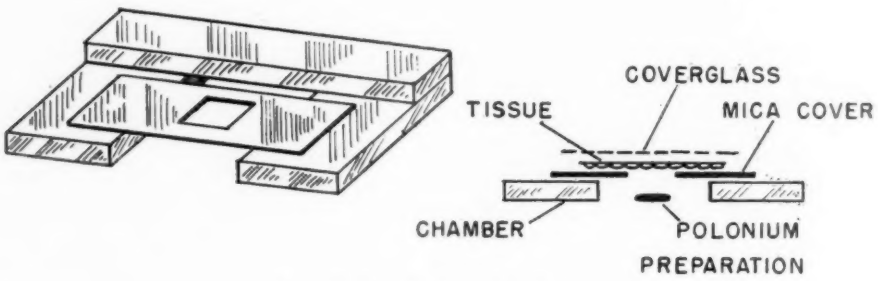

FIG. B. Irradiation chamber.

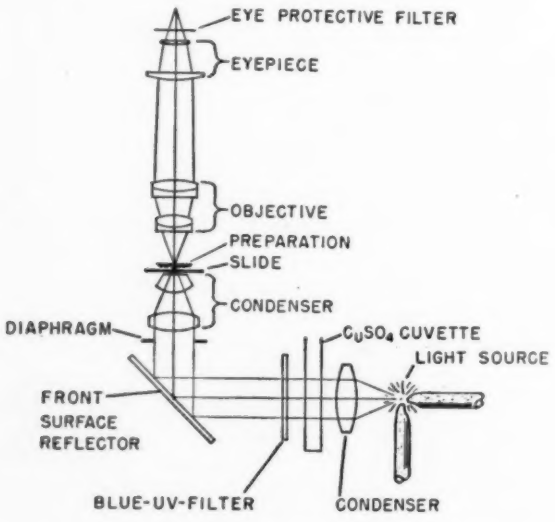

FIG. C. Schematic diagram of fluorescence microscope.

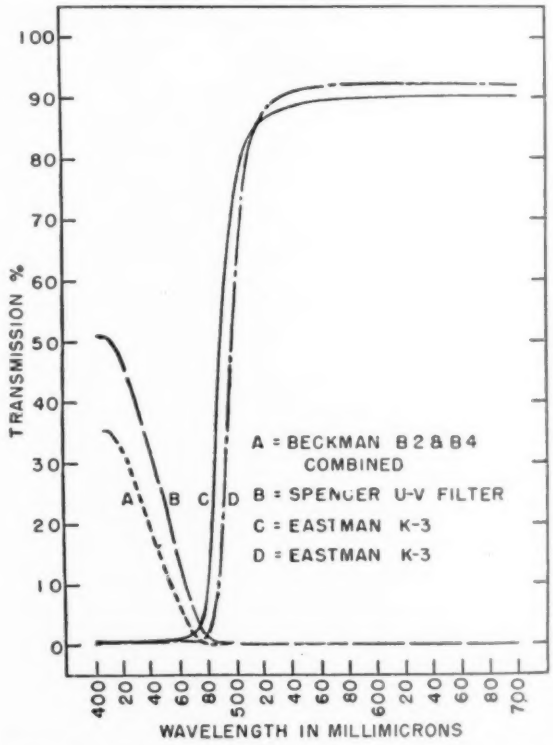

FIG. D. Transmission curves of two blue-ultraviolet filters and two different Eastman K-3 filters.

chrome film proved satisfactory. Proper exposure times were determined by trial exposure first with black and white and later with color film.

As a check on the adequacy of the dye as an indicator of cell viability, the technique was studied with *Allium cepa* epidermis that had been killed by heat in two ways. In the first method, the sections were held in live steam for a few minutes and then stained along with a control section taken from the same onion shell. In the control section, the membranes were red, the cytoplasm greenish-brown, while the nuclei were a brilliant green. Dead epidermis (three minutes in steam) showed a completely different appearance. The membranes, cytoplasm, vacuoles and nuclei fluoresced red. In the second method, living onion epidermis which had been stained in the usual manner and had a normal appearance, was touched in a small area through the cover glass with a hot wire. Immediately, the cells near or in contact with the hot wire developed red cytoplasm and nuclei whereas in surrounding areas where the heat was not so intense, the cells had the original or slightly enhanced appearance of greenish cytoplasm and brilliant green nuclei. Yeast cells respond in the same manner to these tests (color plate, Fig. 7 and 8).

B. *Results*. The same effect, as produced by heat killing, was demonstrated when tissue cells were killed by irradiation. Depending on the strength of the radiation source, the effect becomes more or less quickly manifest during the irradiation. Under the given conditions, *Allium cepa* preparations irradiated with polonium alpha sources that give 10^7 alpha particles/mm.^{2}/min., showed within twenty to thirty minutes a typical change of appearance. A few nuclei appeared brighter green, some others had a yellowish tinge. Others were orange and a few red. Because of the fact that alpha particle hits are a random event, the damaged nuclei show a statistical distribution in the irradiated area (see color plate, Fig. 5).

If the irradiation is continued, the effect becomes more and more pronounced. After ninety minutes' total irradiation of the above specimen, a great number of nuclei have changed their fluorescent light from green to red, thereby indicating that the cell is heavily damaged or destroyed. Parallel work shows that there is no plasmolysis in red cells. Ten hours after irradiation, the section of epidermis has the appearance shown in Figure 6. All the cells are red, the cytoplasm is coagulated and separated from the cell walls and lies as a small, tortuous cloud in the center of the cell.

Identical effects have been produced in yeast cells. Also here, depending on the irradiation strength and the time of exposure, the number of red fluorescing yeast cells gradually increases. It is a simple matter to observe the process and to count the number of green or red fluorescing cells as a function of time.

These experiments indicate the approximate amount of alpha radiation necessary to kill the cells. Rough estimates show that when *Allium capa* epidermis was bombarded under the above specified conditions, the employed millicurie source of alpha particles from polonium kills about 50 per cent of the cells after an irradiation time of thirty minutes. Earlier, Herčik,[2] studying the effects of alpha irradiation on *Allium cepa* epidermis and using post vital staining techniques, calculated that 25 to 30×10^7 alpha particles/mm.^{2} are necessary to kill 50 per cent of the cells, although the sensitivity of the cell depended somewhat on the type of onion and on seasonal variance.

SUMMARY AND CONCLUSIONS

Using the acridine orange vital staining technique, the results of earlier preliminary investigations have been confirmed and extended. The findings are:

1. Cells and cell groups irradiated before staining and also irradiated stained cells demonstrate the radiation effect by a color change in the emitted fluorescent light as they become non-viable. When normal, the cells have a green fluorescence. When completely destroyed, the cells have a bright red fluorescence.

2. Intermediate stages or degrees of

radiation damage are characterized by shades of yellow or orange fluorescence.

3. These changes occurring in cells under alpha radiation have been fixed on color film.

4. The amount of irradiation necessary to kill cells can be readily quantitated.

By this means it is possible to study some of the details of radiation damage. The results reported together with the photomicrographs amply justify the use of the acridine orange vital staining method in radiobiology.

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FIG. 1. Living onion epidermis. Bright green cytoplasm and nuclei and bright brick red membranes. All cells are alive. Section under coverslip about thirty minutes.

FIG. 2. Living onion epidermis—from a different onion. Greenish cytoplasm, bright green nuclei and orange membranes. All cells living.

FIG. 3. Partially irradiated section. The corner with the bright green nuclei has been protected by a sheet of mica. The rest of the onion has been strongly irradiated with polonium alpha rays. The irradiated area is markedly different from the covered area; the cytoplasm is orange red, the nuclei are bright red with shades of yellow and a few yellowish green. There is a characteristic vacuole contraction and the cells have begun to change color.

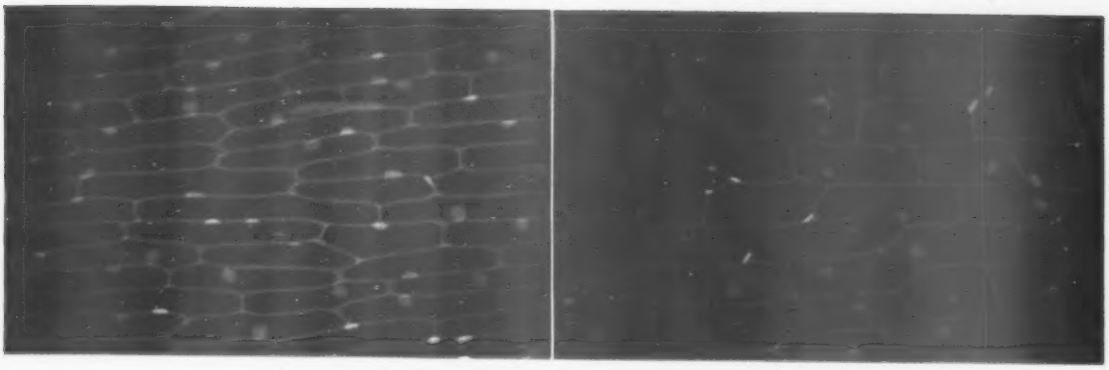
FIG. 4. One-half of onion section irradiated and the other half covered with mica. The unirradiated portion has the characteristic appearance while on the irradiated side the cytoplasm has shrunken, is orange colored the vacuoles have contracted and many of the nuclei are reddish in color.

FIG. 5. Onion section totally irradiated but with not enough dose to kill all the cells. There is a random distribution of green nuclei, i.e., live cells, as expected in statistical events. Notice the vacuole contraction in cells with red nuclei and the change in color of the cytoplasm and its granular appearance.

FIG. 6. Complete destruction of onion section. Irradiated for such a long time that all of the cells are irreversibly killed as apparent by the color change in the nuclei and cytoplasm. The vacuole is contracted and the protoplasm is seen as a tortuous contracted cloud.

FIG. 7. Yeast cells. Control preparation with a large proportion of the cells in the living state, as shown by the green fluorescence. Only an occasional cell is dead.

FIG. 8. Preparation from same suspension as in Figure 7 but heated for a short time to 80° C. The cells have changed color from green to yellowish and most are already red.



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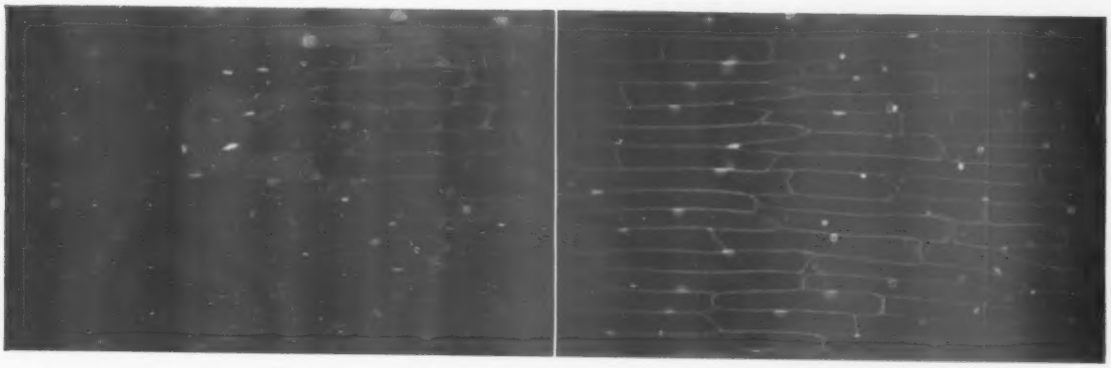

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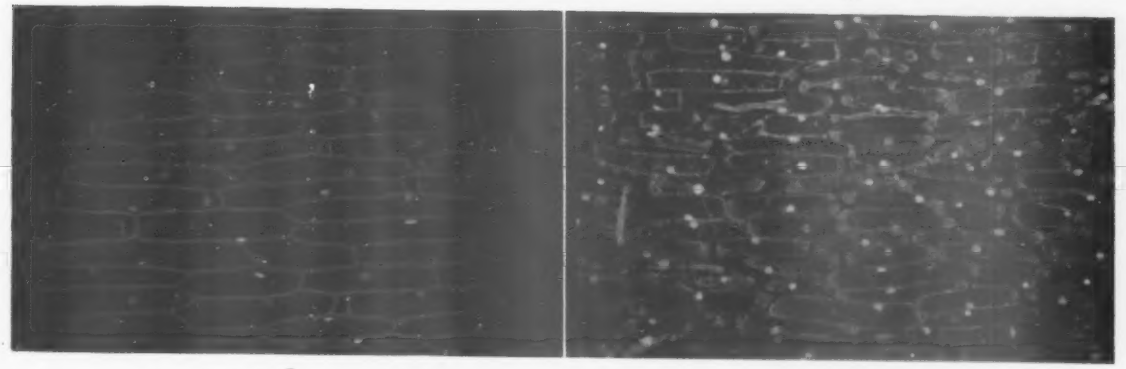

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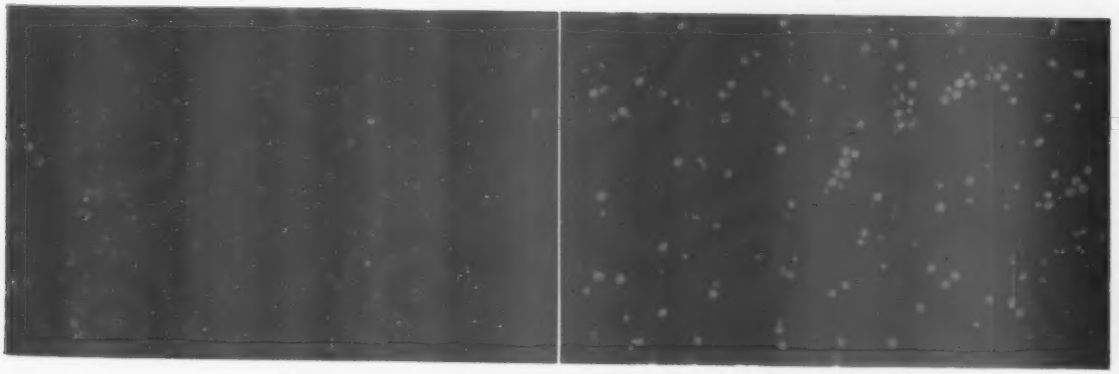

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Vol. 65, No. 1

RECOMMENDATIONS OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL UNITS (LONDON 1950)

Report Prepared by Members of the International Commission on Radiological Units as Follows:

W. V. Mayneord, *Chairman*, Great Britain; L. S. Taylor, *Secretary*, United States; W. Binks, Great Britain; R. Coliez, France; F. Ellis, Great Britain; G. Failla, United States; H. Holthusen, Germany; G. C. Laurence, Canada; R. R. Newell, United States; W. J. Oosterkamp, Holland; B. Rajewsky, Germany; R. Sievert, Sweden; A. Tivoli, Italy

SECTION: A UNITS

1. For the correlation of the dose of any ionizing radiation with its biological or related effects the International Commission on Radiological Units (I.C.R.U.) recommends that the dose be expressed in terms of the quantity of energy absorbed per unit mass (ergs per gram) of irradiated material at the place of interest.

In the foregoing paragraph by "energy absorbed" is meant the energy imparted to the material by ionizing particles at the place of interest.

2. Inasmuch as calorimetric methods are not usually practicable, ionization methods are generally employed. For this purpose the quantity which must be measured is the ionization produced in a gas by the same flow of corpuscular radiation as exists in the material under consideration. The energy, E_m, imparted to unit mass of the material, is then essentially related to the ionization per unit mass of gas, $\mathcal{J}_m$, by the equation:

$$E_m = W s \mathcal{J}_m$$

where W is the average energy expended by the ionizing particles per ion pair formed in the gas, and s is the ratio of the mass stopping power of the material to that of the gas.

3. Since the calculation of the dose in absolute energy units from measurements of ionization requires a knowledge of the parameters W and s as well as variables characterizing the radiation and the irradiated material, the I.C.R.U. is of the opinion that tables of the best available data should be prepared as soon as possible and held under continual revision.

4. The Commission considers that the roentgen (designated by the symbol r), in view of its long established usefulness, should continue to be recognized as the unit of X- and gamma-ray quantity or dose and that its definition remain unchanged.

The roentgen shall be the quantity of X or gamma radiation such that the associated corpuscular emission per 0.001293 gram of air produces, in air, ions carrying 1 electrostatic unit of quantity of electricity of either sign. (See Appendix, Note 1.)

5. It becomes increasingly difficult to measure the dose in roentgens as the quantum energy of the X radiation approaches very high values. The unit may, however, be used for most practical purposes for quantum energies up to 3 mev.

6. The I.C.R.U. does not recognize the use of special names or symbols for quantities which are merely multiples of the fundamental unit. (This does not preclude the use of generally used prefixes such as kilo-, milli-, etc.)

7. The I.C.R.U. recommends that the curie be used for the measurement of radioactive materials and that the definition be as follows:

The curie is a unit of radioactivity defined as the quantity of any radioactive nuclide in which the number of disintegrations per second is 3.700×10^{10}.

This definition is in accordance with the definition of the curie adopted by the Commission on Standards, Units, and Constants of Radioactivity appointed by the Inter-

national Council of Scientific Unions. The Commission notes that when the curie is defined in this way the only point of revision which could arise would be the number of curies in 1 gram of radium. It is very improbable that this number would differ from unity by an amount of clinical significance, although the distinction would clearly have to be taken into account in accurate radium standardization.

8. It is suggested that the gamma-ray emission be expressed in terms of r/mc.hr. at 1 cm. from a point source. As this quantity is different for every isotope the Commission will undertake the compilation of data relating to the gamma-ray emission of radioactive isotopes.

9. The I.C.R.U. requests the national standardizing laboratories to set up, interchange and compare standards of roentgen rays, gamma rays and radioactive isotopes, maintain close contact with each other, and generally by every means within their power further the improvement of methods of standardization.

SECTION B: DOSE OR THE SPECIFICATION OF THE CONDITIONS OF ROENTGEN TREATMENT

After discussion the I.C.R.U. agreed to postpone the revision of Section B, which remains as follows:

10. In the description of the conditions of roentgen treatments, distinction shall be made between the quantity of radiation measured in air and the quantity of radiation estimated to have been received by the tissue. Since the symbol r is reserved for the unit, the amount of the dose may be designated by the letter D. The use of subscripts is suggested to distinguish dosage measurement made under different conditions; e.g. in free air—D; at the surface of the skin (including back-scatter)—D_0, etc. (See Appendix, Note 2.)

11. The specifications of treatment conditions shall include the following:

I. *Quantity*. The quantity of radiation (expressed in roentgens) estimated to have been received by the lesion.

II. *Quality*. (a) The spectral energy distribution of roentgen radiation shall be designated by some suitable index, called quality. For most medical purposes it is sufficient to express the quality of the roentgen radiation by the half-value layer in a suitable material: Up to 20 kv. (peak) cellophane or cellone; 20–120 kv. (peak) aluminum; 120–400 kv. (peak) copper; 400 kv. up (peak) tin. For a more definite specification of the quality of the radiation the complete absorption curve in the same material is preferable.

(b) Material and thickness of filter including tube walls.

(c) Target material.

III. *Technique*. (a) Total quantity of radiation per field (incident and emergent) received in an entire course of treatment.

(b) Quantity of radiation per field measured at the surface (D_0) at each individual irradiation.

(c) The dosage-rate expressed in r per minute (r/min.) during each individual irradiation.

(d) The total time over which a course of treatments is spread.

(e) The time interval between successive doses.

(f) The target-skin distance.

(g) The number, dimensions and location of the ports of entry.

SECTION C: DOSE OR THE SPECIFICATION OF THE CONDITIONS OF GAMMA-RAY TREATMENTS

12. The specification of the conditions of gamma-ray treatments should, where possible, include statements of:

I. *Quantity*. The total quantity of radiation (expressed in roentgens) estimated to have been received by the lesion.

II. *Particulars of Radioactive Source.*

(a) The total amount and nature of radioactive substance employed (expressed as equivalent milligram of radium element).

(b) Type, number, and distribution of the containers.

(c) The material and thickness of filters and the nature of the material externally adjacent to the skin.

III. *Technique.*

(a) In the case of surface applicators or "large radium units," the quantity of radiation per field at the surface.

(b) The dosage-rate during each individual irradiation.

(c) The total time over which a course of treatments is spread.

(d) The time intervals between successive irradiations.

(e) In the case of surface applicators or "large radium units," the radium-skin distance.

(f) The number, dimensions, and situations of the ports of entry.

SECTION D: INSTRUMENTS

13. The following types of apparatus are suggested as suitable for the measurement of quantity in roentgens:

(a) *Roentgen-ray Primary Standards.* The free air chamber shall be used for free air measurements for all wavelengths down to the practical limit set by the consideration that the chamber must be of such width and length that the full ionization produced by the corpuscular emission from air is measured in accordance with the definition (Section A, 4). An air-wall chamber which meets the requirements of the definition may be used for harder radiations.

(b) *Roentgen-ray Practical Instruments.* The air-wall chamber may be used for clinical measurements of roentgen-ray quantity over the entire voltage range.

(c) *Gamma-ray Standards and Practical Instruments.* The air-wall chamber may be used for the measurement of primary or scattered radiations, or a combination of both.

14. Instruments used to measure radiation quantity or dosage may conveniently be called dosemeters and dosage-rate (or dose-rate) meters, respectively, and shall be calibrated in roentgens or roentgens per minute.

15. The calibration readings of dosemeters and dosage-rate meters should be independent of the wavelength within the range for which they are designed or used.

16. Dosemeters and dosage-rate meters should be provided with suitable arrangements (e.g. standard radium source, Bronson leak, or capacity sharing device) for checking the reproducibility of their readings.

17. The calibrations of dosemeters or dosage-rate meters should be tested periodically, by a recognized testing laboratory, over the range of wavelengths for which they are designed or used.

18. The national standardizing laboratories shall be invited to undertake standard measurement and the calibration of dosemeters relative to all forms of radiation therapy to which these recommendations may apply. They shall also be invited to issue joint reports from time to time thereon.

SECTION E: APPENDIX

Note 1. Note that 0.001293 gram is the mass of 1 cc. of dry atmospheric air at 0°C. and 760 mm. of mercury pressure.

Note 2. For example, in an hypothetical case of medium roentgen rays:

The dose measured in air, D equals 300 r.

The dose measured at the surface, D_0 equals 500 r.

The dose measured at x cm. depth, D_x equals 200 r.

(D is not to be confused with the energy actually absorbed by the tissue.)

SECTION F: RULES GOVERNING THE SELECTION AND WORK OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL UNITS

19. (a) The International Commission on Radiological Units (I.C.R.U.) shall be composed of not more than twelve (12) members. The selection shall be made by the International Executive Committee (I.E.C.) from a list of nominations submitted by the national delegations and by

the I.C.R.U. itself. Members of the I.C.R.U. shall be chosen on the basis of their recognized activity in the field of radiological units and standards, without regard to nationality.

(b) The I.C.R.U. shall be composed of at least three medical radiologists and three physicists.

(c) The members of the I.C.R.U. shall be selected during one International Congress to serve through the succeeding Congress. Not less than two but not more than four members of the I.C.R.U. shall be changed at any one Congress. In the intervening period a vacancy caused by conditions beyond control of the I.E.C. shall be filled on the recommendation of the I.C.R.U.

(d) In the event of a member of the I.C.R.U. being unable to attend the I.C.R.U. meetings, a substitute may be selected by the I.C.R.U. as a temporary replacement. Such a substitute member shall not have voting privileges at the meetings unless specifically authorized by the I.E.C.

(e) The I.C.R.U. shall be permitted to invite individuals to attend its meetings to give special technical advice. Such persons shall not have voting privileges, but may ask permission to have their opinions recorded in the minutes.

20. The continuance of the policies and records of the I.C.R.U. shall be in the hands of a Secretary of the I.C.R.U. elected by the I.C.R.U. from among its regular members and subject to the approval of the I.E.C.

21. The I.C.R.U. shall familiarize itself with progress in the whole field of radiation units and standards. The Secretary shall be responsible for the preparation of a program to be submitted to the Committee for discussion at its meetings. Preliminary reports shall be prepared and circularized to all members of the I.C.R.U. and other specially qualified individuals at least six months before the meeting of the Congress.

22. The Chairman shall be elected by the I.C.R.U. at least six months in advance of the Congress. The choice shall not be limited to the members of the I.C.R.U. or to the country in which the Congress is held. Such a chairman shall be a member of the I.C.R.U., *ex officio*, but for the period of the Congress only. Meetings between Congresses shall be presided over by the Secretary or other member selected by the I.C.R.U.

23. Decisions of the I.C.R.U. shall be decided by a majority vote, with the Chairman casting the deciding vote in case of a tie. A minority opinion may be appended to the minutes of a meeting if so desired by any member and upon his submission of same in writing to the Secretary.

L. S. Taylor, Secretary
Radiation Physics Laboratory
National Bureau of Standards
Washington 25, D.C.

Vol. 65, No. 1

GAS INSULATION

A NEW TREND IN ROENTGEN-RAY APPARATUS*

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MILWAUKEE, WISCONSIN

IN ORDER to perform its function properly, the electrical energy which is converted to radiant energy by a roentgen tube must be confined to prescribed areas. The media which are employed to accomplish this confinement come under the general heading of insulation with subclassifications including solid, liquid and gaseous materials. Early designs of roentgen-ray apparatus used air as the major insulation since it was common and easy to handle. Then, as the trend to smaller and shockproof equipment grew, air was gradually replaced with materials having higher dielectric strength. For instance, high voltage conductors were encased in rubber to become cables, and high voltage generating equipment and tubes were immersed in transformer oil. Transformer oil has played an important part in the advance of roentgen-ray technology and now is used quite generally, except in supervoltage apparatus.

GAS INSULATION IN SUPERVOLTAGE APPARATUS

In supervoltage apparatus, where a large volume of insulation is required, transformer oil has not been very helpful because, among other things, its weight becomes prohibitive. Gas has been the insulation of choice in this specialized field but it has been used in a compressed state in order to improve its dielectric strength. For example, air and nitrogen have been used at pressures up to several hundred pounds per square inch.

A search for gases having higher dielectric strength than air was made some years ago by Charlton and Cooper.[3] From this work, dichlorodifluoromethane (freon 12), having a strength approximately 2.5 times that of air, was selected as the most desirable, and subsequently used in 1 million volt and 2 million volt generators at a pressure of 60 pounds per square inch.[5] Later Cooper,[8] Camilli and Chapman,[2] and others, found that sulphur hexafluoride (SF_6) at high pressure is even more desirable as an insulating medium than freon 12. During the last year it has been applied advantageously to a 250 kilovolts peak therapy apparatus—which is in a voltage range where oil has been used extensively.

SF_6 IN DIAGNOSTIC APPARATUS

SF_6 has now been applied to a 100 kilovolts peak, 100 milliampere, full wave rectified generator, intended for military as well as civilian use in diagnostic apparatus. This new design is particularly significant because for the first time the gas has been put to practical use at atmospheric pressure. By so doing, a very simple apparatus has resulted, having advantages of reliability of operation, ease of installation and repair, cleanliness, and, of course, lightness of weight not obtainable with oil insulation.

As a result, it now seems probable that SF_6 may have wide application in the roentgen-ray field, rather than being limited to large therapy and industrial apparatus as has been the case in the past. In order to extend the application of this gas, new roentgen-ray apparatus will require special design in order to take advantage of the unique electrical, physical, and chemical properties of SF_6. Following is a discussion of the properties which have received consideration in roentgen-ray work.

ELECTRICAL PROPERTIES

The electrical property of prime importance is its dielectric strength, or insulating values. With every fluid insulation there lies the danger of contamination with

* Presented at the Sixth International Congress of Radiology, London, July 23–29, 1950.

other materials which may affect its dielectric strength. In an effort to utilize SF_6 in the simplest possible way, the most likely contaminating substance was air; so a study was conducted to determine the effect of different amounts of air in the phenomena in SF_6 than in air and a greater ratio of improvement for a point gap than for a sphere gap. Pollock and Cooper[10] propose the theory that sulphur hexafluoride may be classified as a negative-ion-forming gas. The formation of negative

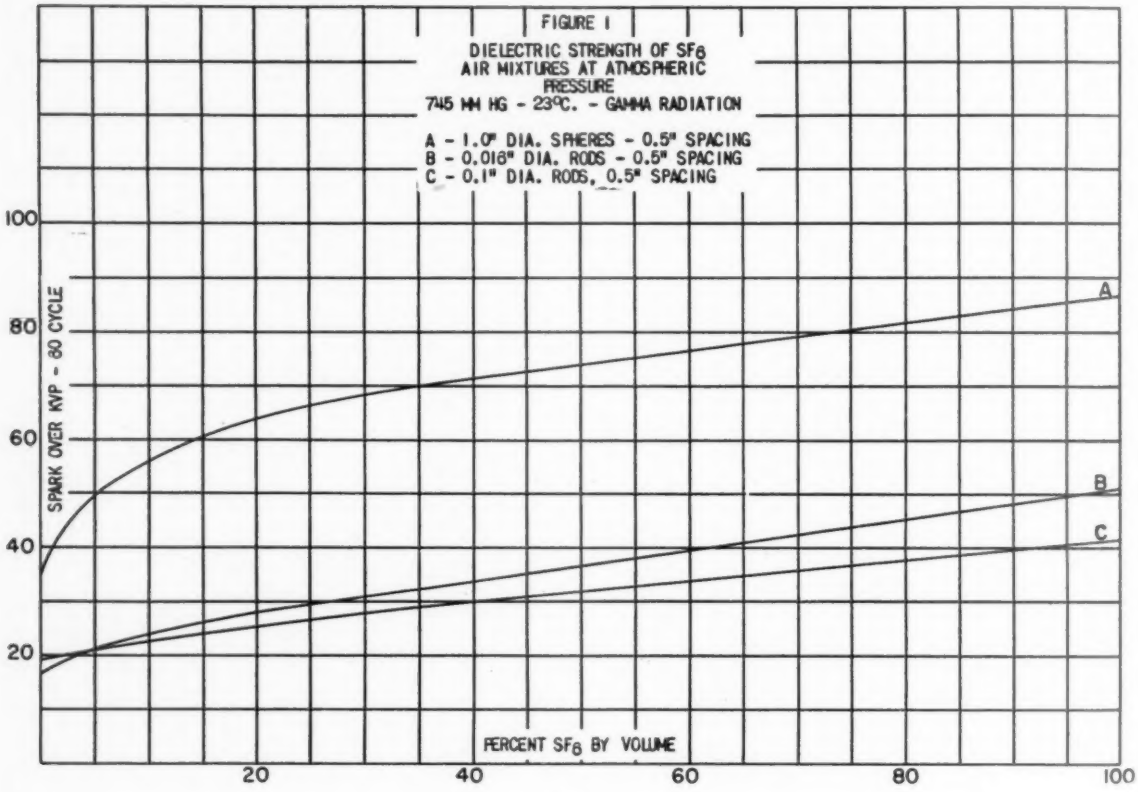

FIG. 1

gas. The resulting data are shown in Figure 1. Among the points of significance are: first, that the spark-over voltage in pure SF_6 is 2.3 to 3.0 times that in pure air (depending upon the spark-gap configuration) and, second, that a little air in SF_6 makes only slight difference in spark-over voltage. For example, with the sphere gap, Curve A, breakdown occurs at 35 kilovolts peak in pure air, 84 kilovolts peak in a mixture of 90 per cent SF_6 and 10 per cent air, and 86 kilovolts peak in pure SF_6. The corresponding values for the point gap, Curve B, are 16.5, 48, and 51 kilovolts peak. To the electrical engineer, the different shapes of these two curves are quite interesting, indicating different breakdown ions in an electric field increases the dielectric strength of the gas by choking off the flow of streamer currents which precede breakdown. Breakdown of air initiates with the formation of electrons and positive ions, the electrons having higher mobility because of the difference in mass. Sulphur hexafluoride forms negative ions and positive ions, both having the same mobility. The effect of the relatively low mobility is that of increasing the radius of the electrodes with the consequent reduction of field stresses.

As shown in Figure 2, gamma irradiation of a spark gap insulated with SF_6 has a material effect upon its short time (one minute) breakdown strength. This is of

both theoretical and practical interest,[1,9] particularly in roentgen-ray apparatus where appreciable radiation may be encountered. Tests indicate that different intensities of gamma radiation do not appreciably change Curve B.

suspended particles and minute air bubbles lining up at points of greatest stress, and materially reducing the over-all dielectric strength.

Spark-overs in SF_6 do not produce electrically conducting products as they do in

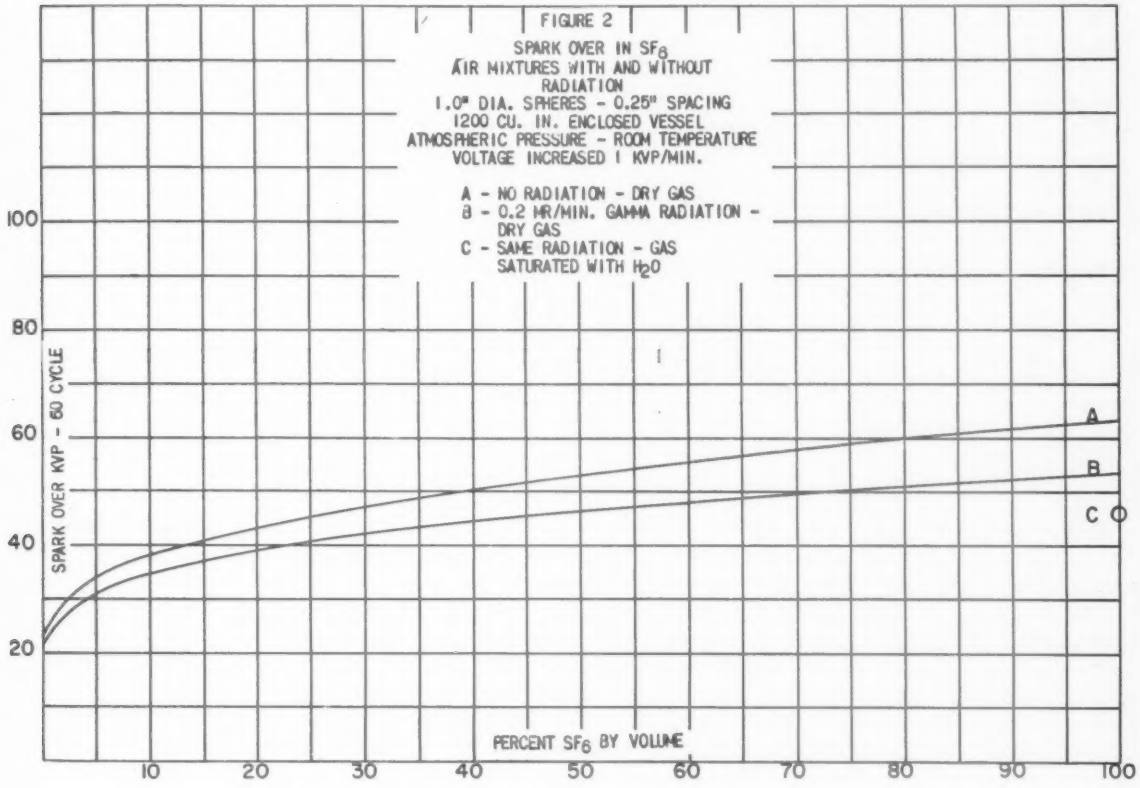

Fig. 2

Point C of Figure 2 shows the effect of saturated water vapor on the dielectric strength. In this case, water was standing in the bottom of the test vessel.

Figure 3 shows the effect of different gas pressures. The breakdown voltage increases with pressure, as has been indicated earlier, and it is for this reason that pressures of the order of 60 pounds have been used in supervoltage apparatus. However, even at atmospheric pressure, only slightly greater electrical spacings are required in SF_6 than in transformer oil. Since oil is subject to deterioration, a greater safety factor is necessary in its application. Theoretically, oil should be much better, but part of this advantage is lost due to such things as oil and certain gases where carbonization can occur. This is one of the reasons why the gas is preferred to freon 12. Advantage can be taken of this fact to introduce a limiting spark gap designed to have a lower spark-over voltage than any other part of the circuit. The intent is to prevent spark-over of solid insulation which would result in permanent failure. Then, if the insulation strength is reduced for any reason whatever, spark-over occurs at the limiting gap, a circuit breaker is opened in the control circuit and no permanent damage results.

Since, in any practical application of an insulating medium, there lies the possibility of a leak, an experiment was run to test the

dielectric strength within a container of SF_6 having an orifice to air of known dimensions. To simulate operating conditions and to stimulate the exchange of air and gas molecules, a source of heat energy was placed within the container and operated periodically. It is interesting to note that the dielectric strength only dropped 14 per cent in a seventeen hour period, indicating that about 40 per cent of the gas had been replaced by air. The data are shown in Figure 4.

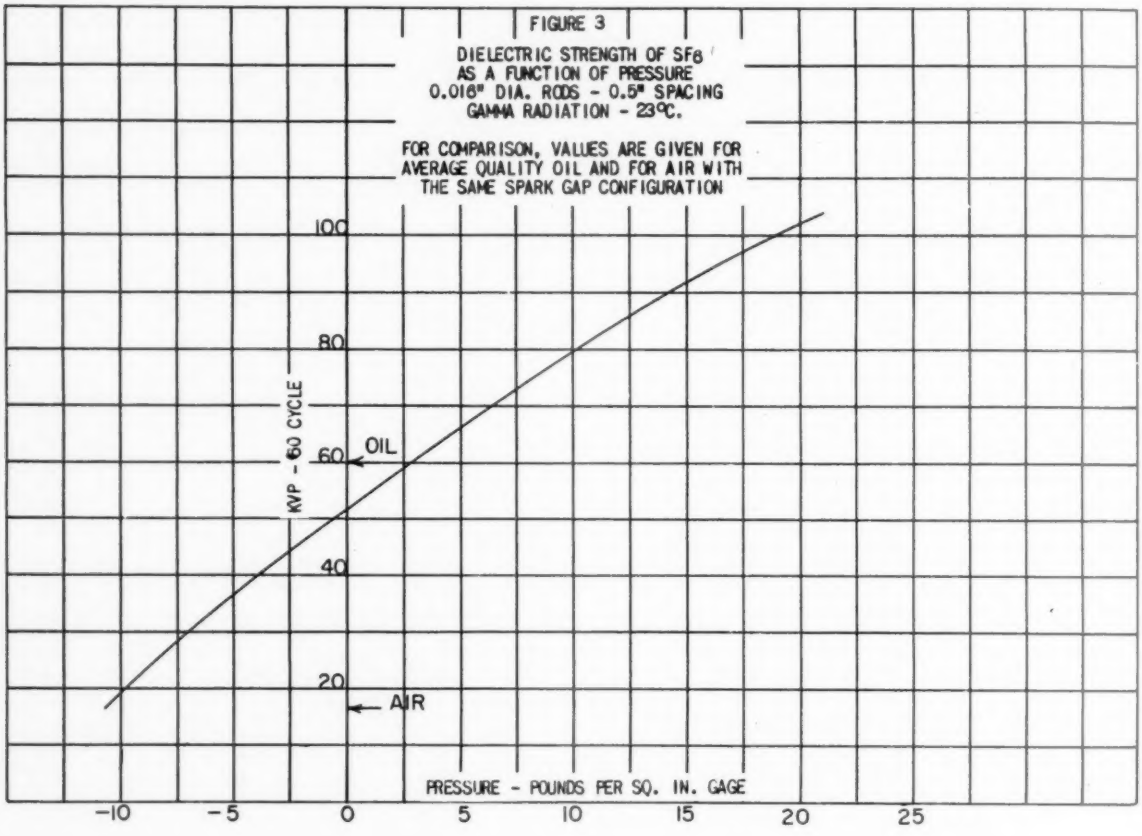

FIG. 3

PHYSICAL PROPERTIES

Since the density of SF_6 is 5.1 times that of air, the rate of diffusion is relatively slow. Therefore, the gas may be poured into an open container and almost completely displace the air. After the container is sealed off, the mixture will, in time, be uniform, because the gases are completely miscible. Since it has been shown that a slight amount of air makes little difference in breakdown strength, the way is obviously opened for a simple apparatus and procedure for filling and repair. Its realization is illustrated by the procedure adopted for filling the 100 kilovolts peak generator mentioned earlier, which, incidentally, requires less than 2 pounds of gas for a complete filling.

A flexible hose attached to a small cylinder of gas is dropped into the generator through a hole in the top of its tank. The cylinder valve is then opened and gas allowed to flow until a small flame at the tank opening is extinguished. Since the gas is colorless and odorless, its non-flammability is employed as a detector of the level. The hose is then removed and the tank opening closed by means of a gasketed plug. The generator is immediately ready for operation. It is even practical to make minor repairs such as kenotron replacement without replacing the gas lost during the repair. For example, for kenotron replacement a

cover is removed from an opening in the bottom of the tank just large enough to give access to the kenotrons. The cover need be off for not longer than five minutes and during this time diffusion is so slight that mixture of not more than 5 per cent air is obtained.

The heat capacity, of course, does not approach that of transformer oil, and appears to be just slightly better than that of air. The heat problem has been solved in the 100 kilovolts peak generator by details of the transformer design, by specially designed low-wattage kenotrons mounted at the bottom of the tank, and by a simple fan to provide some movement of the gas. In a roentgen tube housing, heat dissipation is aided by a larger tube radiator and by ability to operate at a much higher temperature than in oil. Ordinary transformer oil starts to decompose at a temperature of about 90° C., whereas in SF_6 the gas around the radiator can be allowed to rise to a temperature of the order of 300° C.

Other significant physical properties[11] include a sublimation point of −63.8° C. (i.e., temperature at which it changes from a solid to a gaseous state). This is low enough to impose no limitation on world-wide shipment or operation. It liquefies at 330 pounds pressure at room temperature, so that it can be safely shipped in small cylinders of the type used for medical gases. In the normal temperature-pressure range it behaves like a perfect gas, which means that roentgen-ray apparatus in which it is used can be sealed at atmospheric pressure and then will vary only a few pounds positive or negative during temperature variations in operation or shipment. The apparatus enclosure need not resist much pressure, and therefore can be light in weight, particularly if cylindrical in shape.

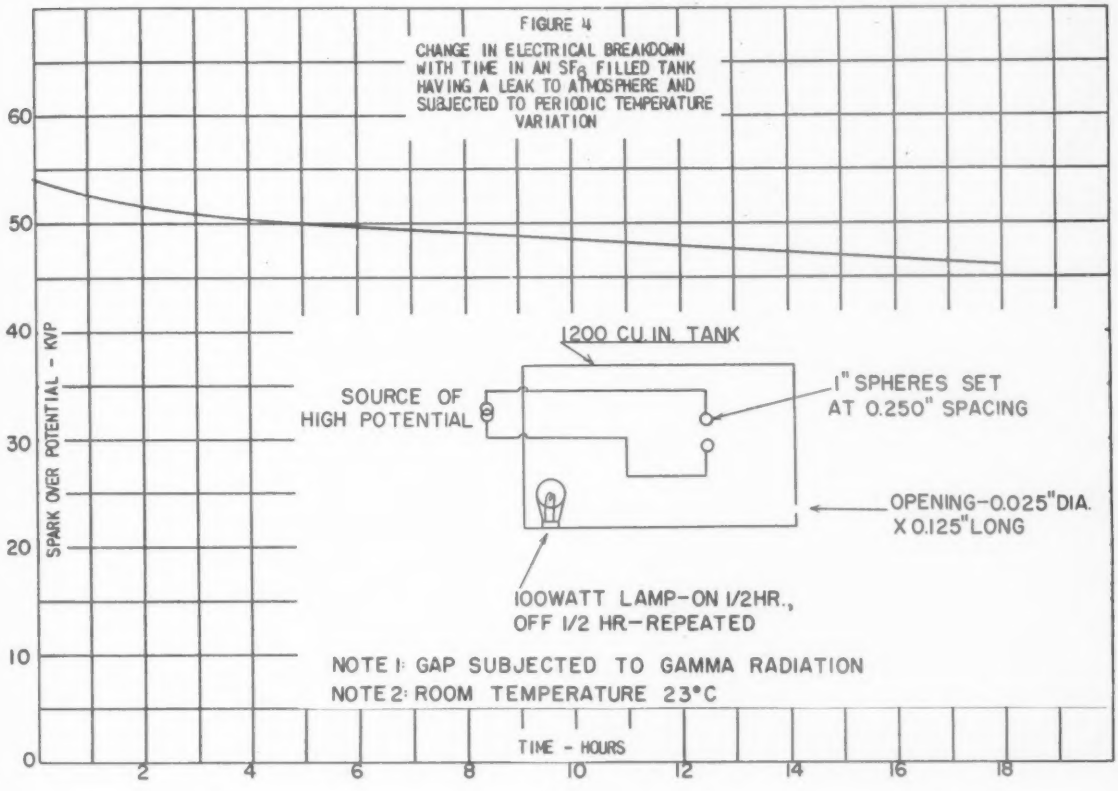

FIG. 4

CHEMICAL PROPERTIES

SF_6 is colorless, odorless, non-flammable and has a high degree of thermal and chemical stability.[11] It is very pure and

non-toxic as commercially supplied. This is indicated by the fact that on each lot of gas manufactured, control tests are made which involve immersing white rats in an atmosphere of 80 per cent SF_6 and 20 per cent O_2 for a number of hours without evidence of injury.

Questions arose during development of the 100 kilovolts peak generator as to whether there could be an appreciable decomposition of SF_6 during operation or after occasional spark discharges. The questions were: (1) would any decomposition products damage the materials of the transformer, and (2) would they be toxic? The first question was easily settled in the negative.[2] The second question, which has also been raised in the literature,[12] appears to be negative in this apparatus because of a very limited spark-over current—of the order of 0.5 ampere.

The following tests on spark-overs were made in conjunction with the supplier and Yale University: Five samples of SF_6 were subjected to sparking in the presence of 10 per cent air. Each sample was sparked five times, totaling nine seconds' duration, and differed as to the absence or presence of vaseline contamination on the sparking electrodes, and the absence or presence of activated alumina as an absorber. The samples were shipped to the supplier where a portion was used in chemical analysis, and the remainder sent to Yale University for toxicological tests. The report from the supplier indicated no detectable SO_2 or soluble H_2SO_4 in any sample, and only approximately 0.01 per cent soluble fluorides. The report from Yale University showed no toxicity.

The results of these tests are not conclusive because of their short duration, but in conjunction with other data and considerable experience with SF_6 in supervoltage apparatus, there is good reason to believe that decomposition is slight in roentgen-ray apparatus during normal operation, or even after breakdown. Nevertheless, for added safety factor, it is recommended that a cartridge of activated alumina be placed in the gas enclosure. This material has the property of absorbing slight amounts of decomposition products, and also water vapor which, as Figure 2 indicates, is undesirable from a dielectric standpoint.

CONCLUSION

Sulphur hexafluoride (SF_6) has properties which when properly utilized give advantages in small low voltage roentgen-ray apparatus as well as in large high voltage apparatus. For simplicity of design, it can be used at, or near, atmospheric pressure, and with some air contamination. As time goes on, it should have wide application.

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SENSITOMETRY IN ROENTGENOLOGY*

By J. F. RODERICK, R.T.
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FIVE years before the discovery of roentgen radiation, the need for a scientific method to evaluate the characteristics of photographic plates was acute. A basic procedure was established which exists in improved form and is widely used in the field of photography today. The method is employed by roentgen-ray film manufacturers to determine and improve the quality of their products and, to a very limited degree, it is used by consumers. A search of roentgenologic journals and textbooks reveals very few references to this procedure which is known as sensitometry. In an effort to familiarize more radiologists with this system for evaluating the characteristics of roentgen-ray films. intensifying screens and processing solutions and their ultimate influence on the roentgenogram this paper is offered.

In England, in 1890, Hurter and Driffield studied the problem of accurately measuring photographic emulsion qualities. They pioneered a process and initiated its perfection into a quantitative science which was later improved by many others. Briefly, the procedure was one of giving photographic plates a series of exposures which increased geometrically, developing the plates and measuring the resultant density. Equipment was designed to produce controllable intensities of light and lengths of exposure. Such an apparatus today is known as a sensitometer. Instruments now known as densitometers were designed to measure density or the absorption of light by the exposed and processed material.

Before considering a definition of the term density it is well to note that as metallic silver is deposited in a given area of the film emulsion as a result of exposure and processing, the area absorbs light. Tones or shades of gray are visible. The shade of gray or degree of black in a unit area is measured by the amount of light absorbed in the area. The blackening, measured quantitatively, is defined as density. It is further defined as the logarithm of the opacity in a unit area and expressed;

$$D(\text{Density}) = \log_{10}\frac{E_i}{E_t}\ \begin{matrix}(\text{Light energy, incident})\\(\text{Light energy, transmitted})\end{matrix}$$

The data obtained by sensitometric procedures are usually plotted in the form of graphs. Such a graph is offered as an illustration of the characteristics of a particular photographic emulsion (Fig. 1). The toe of the curve, A-B, demonstrates the response of the emulsion to relatively small quantities of radiant energy. It is

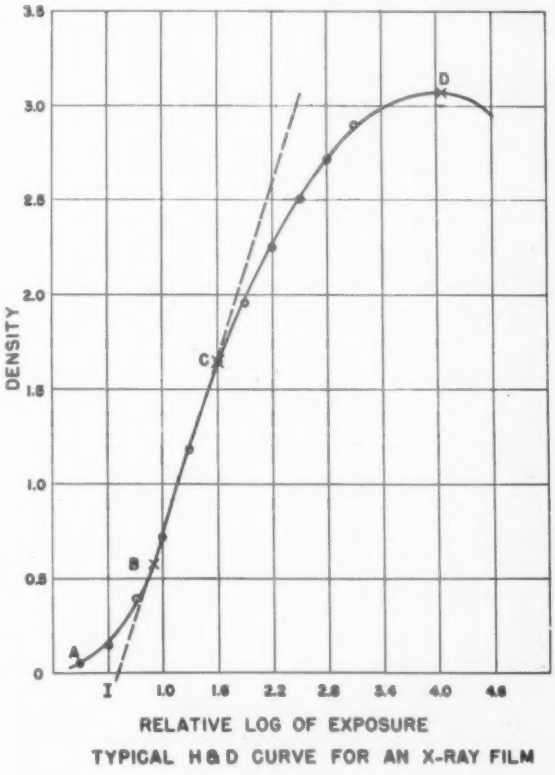


FIG. 1

* From Photo Products Department, Research Laboratory, E. I. du Pont de Nemours & Company, Parlin, New Jersey.

noted that with increases in exposure the density builds up slowly until the main portion of the curve, B-C, is reached. Along B-C the density increases as the logarithm of the exposure. Beyond point C, the shoulder of the curve, additional exposure results in smaller increases in density to the point where additional exposure does

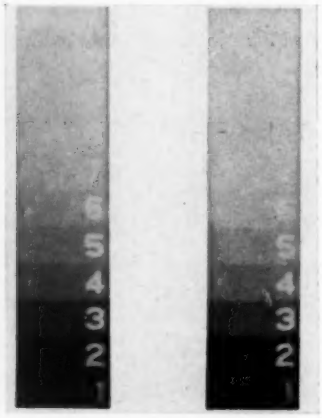


FIG. 2

not produce greater density. In fact, if exposure beyond point D is given the density will become less and reversal will take place.

The range of useful densities on a medical roentgenogram are approximately 0.30 to 2.0 when the average illuminator is used. A lower density is too light to be useful and a higher density is too dark to be of value. The density which produces jet blacks under average present-day viewing conditions is 3.0.

A continuation of the straight line, B-C, portion of the curve intersects the exposure axis and the exposure corresponding to the point where it reaches the axis is termed inertia (I). The reciprocal of the inertia ($1/I$) can be used as a measure of speed or sensitivity. Speed is more frequently expressed in terms of the exposure which produces a definite response. Gamma can be determined by the tangent of the angle formed by the straight line projection (B-C) and the exposure axis. It is frequently used to indicate the contrast and latitude produced under a given set of conditions.

Several individuals studying film strip data can arrive at slightly different results. Sensitivity and gamma are, therefore, frequently calculated by means of mathematical devices and formulae which produce less variable results.

Contrast and latitude are the result of at least four factors: the characteristics of the emulsion, subject contrast, exposure, and development. These qualities are very closely related to one another but the terms can not be used interchangeably. Contrast is the differences in density in the roentgenographic image produced by radiation passed through a subject having a given range of opacities.

High contrast is illustrated on the H and D curve by an extremely large angle formed below the curve by the straight line, B-C, and the exposure axis. Roentgenographically, high contrast is demonstrated by an abrupt change in density for a small change in roentgenographic opacity (Fig. 2). High contrast is also characterized by a failure to produce detail visibility in thick and thin sections of an area of the body simultaneously. Exposure is very critical. Comparatively slight variations or errors in technique produce objectionable variations in density.

Lower contrast and greater latitude are shown on the characteristic curve by a lesser angle formed by the straight line portion of the curve and the exposure axis. A roentgenogram with comparatively less contrast and more latitude permits small differences in opacity to be demonstrated through a wider range of roentgenographic opacities. Increased latitude permits detail to be visualized in thicker and thinner parts of an area and allows greater variations in exposure without serious influence on density or contrast. Also, latitude is desired to minimize the effect of errors in exposure, variations in patient opacity and an exaggerated effect of pathology on the final result.

It is usually considered desirable to produce only sufficient contrast to demonstrate the existing differences in roentgeno-

graphic opacity. Today, additional effort is made to increase latitude by modifying apparatus, accessories, films, and technical procedure.

At least two kinds of latitude are listed in references on sensitometry: the above mentioned latitude of the material, and processing latitude. The latter applies to the range of variations in the time or temperature of development which is possible before contrast, speed or chemical fog is objectionably influenced.

Roentgenographic subject contrast is the result of the differences in roentgenographic opacity of the material and the various intensities of radiation transmitted by it.

The degree of development, in the final analysis, determines the contrast or latitude produced on a roentgenogram. The curves shown in Figure 3 illustrate the influence of several developments in one developer on a particular film.

It is noted on the characteristic curves that as developing time increases from two to three minutes in a typical developer the pitch of the curve increases and the curve shifts to the left. It is apparent that less exposure is required to produce a 0.7 density when three minute development is employed. As development is increased beyond three minutes, progressively smaller changes in contrast and density are observed until a certain developing time is reached. Beyond that point contrast decreases with increased fog. To further elaborate on the effect of development on gamma or contrast and chemical fog these values are plotted against developing time on the chart to the right of the characteristic curves.

Here it is noted that gamma increases with development until maximum contrast is obtained at five minutes. However, as chemical fog increases with developing time it is well to observe that the fog increases from 0.05 to 0.11 as development is increased from three to five minutes at 68° F. If one wishes to visually check this point in his own office, the following procedure and conditions are offered. In total darkness place an unexposed film on a hanger. Insert the bottom half in the developer for three minutes. Then insert the entire film in the developer for an additional two minutes. Rinse, fix, wash the film as usual. Inspect the dry film by holding, against a light surface because the fog densities, minus exposure density, are not usually sufficiently high to be readily visible on the average illuminator.

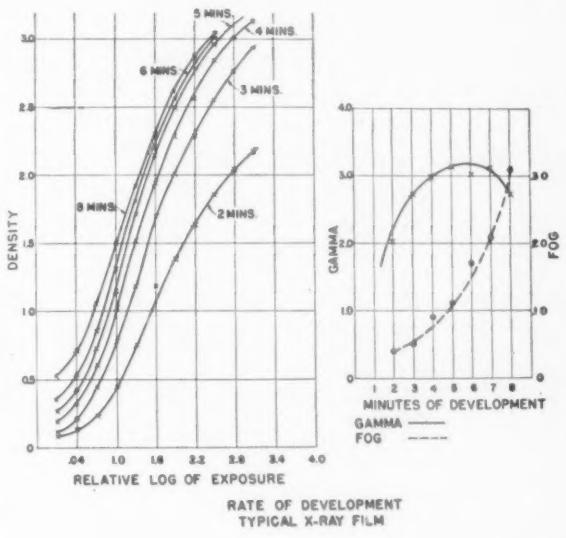


Fig. 3

In research or production quality control evaluations precise exposing techniques are employed which duplicate time, kilovolts peak, and milliamperes in use by consumers. Aluminum stepwedges (Fig. 4) and other systems are used to vary the quantity of exposure reaching a film. All films are processed and dried under very carefully controlled conditions. The resultant film (Fig. 5) is then read on a densitometer from which the sensitometric data are obtained.

Several types of nstruments are used for measuring the densities of the processed film strips. The apparatus may (1) vary the intensity of the light source, (2) reduce the intensity of light by the use of an adjustable sector wheel, (3) polarize the light source, or (4) use light absorbing material

such as optical density wedges. The stroboscopic photoelectric densitometer in wide use in our laboratories was designed by Dr. D. R. White (Fig. 6). It is described as "an ingenious arrangement in which the density to be measured is illuminated through a circular optical wedge which is constantly rotated; the amplified photocurrent varies with the transmitted intensity. The amplifier circuit flashes a stroboscopic light source which illuminates the density scale on the wedge where the reading should be made." The values noted on the density scale of the densitometer are recorded. Speed and contrast values are then obtained with the aid of mathematical devices. In the process, fog data are noted and subtracted. In this manner the characteristics of the recording material are obtained and evaluations may be made.

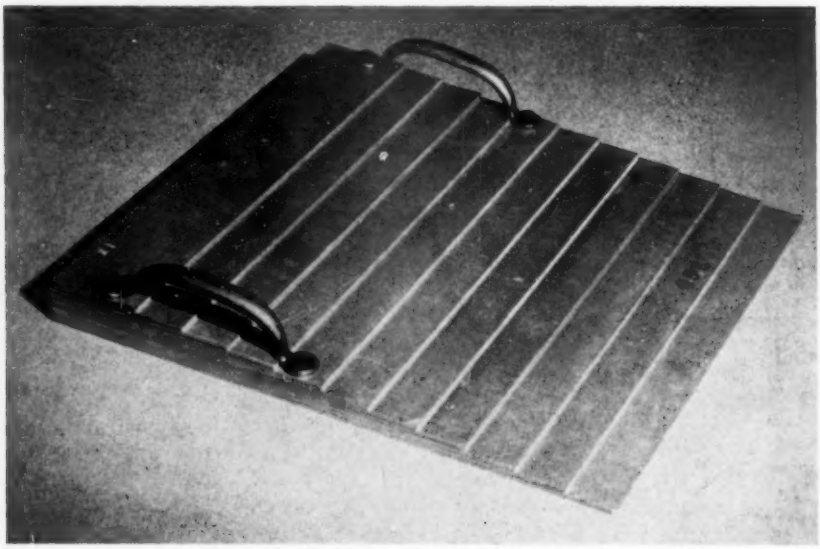


FIG. 4

FIG. 5

It has been stated that several factors influence the density and contrast of a roentgen-ray film. Included in these factors are the kilovoltage range used, the filtration of the roentgen rays, the length of exposure and the type of intensifying screens. To determine the influence of these factors sensitometrically, it is necessary to elaborate on the methods already outlined and to employ some variations in the form used to present the data. Exposing, processing, drying and evaluating the effect of intensifying screens require precise con-

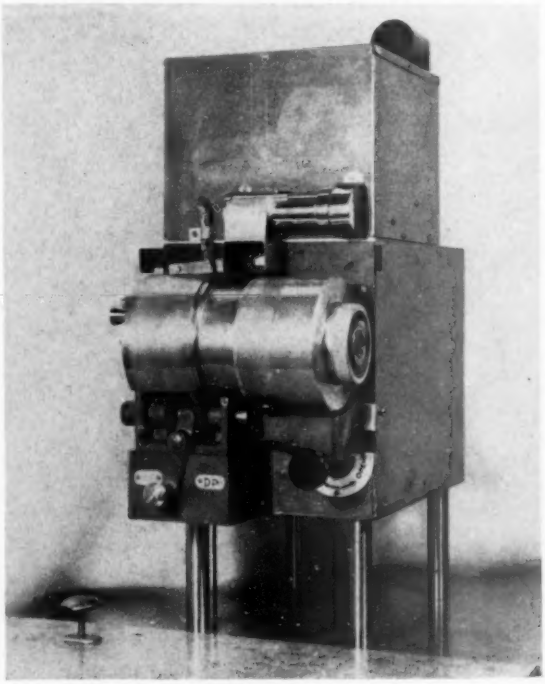


FIG. 6

trol of all the factors which could influence the results.

Exposures are made by means of a sensitometer which produces a series of exposures of increasing intensity. A standard film is partially covered with intensifying screens during exposure. After development the two density scales are noted. One produced by the action of roentgen rays alone and the other by the light given off by the screens and roentgen rays. The results are plotted in curve form as shown in Figure 7.

The intensification factor is defined as the ratio between two exposures which is necessary to produce duplicate densities. Since there is a difference in the shape of the two curves in the illustration it is evident that the intensification factor depends upon the density at which it is calculated. As the average roentgenographic density of the diagnostic areas of a roentgenogram is generally considered to be

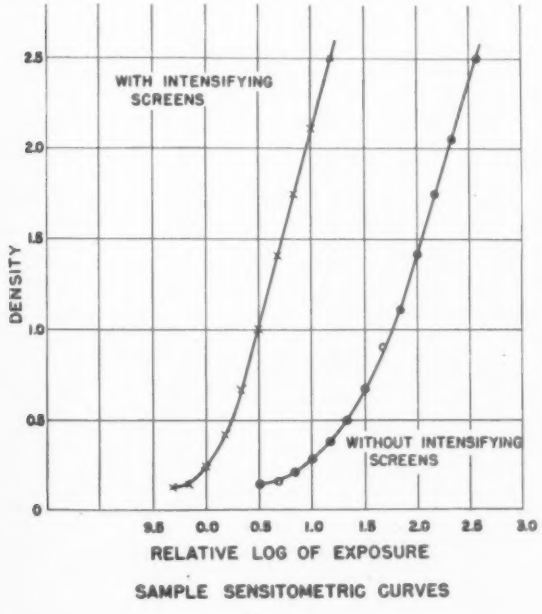


Fig. 7

0.7, the intensification factor is usually calculated at that density. Not only do the above curves indicate the reduction in exposure possible with intensifying screens to obtain a satisfactory density but the pitch or slope of the curves also indicates that contrast is much greater when intensifying screens are used.

The above mentioned 0.7 density was determined in our laboratories by a very inclusive series of tests. Films with various contrasts were exposed with several techniques and developed under many conditions. The resultant large number of

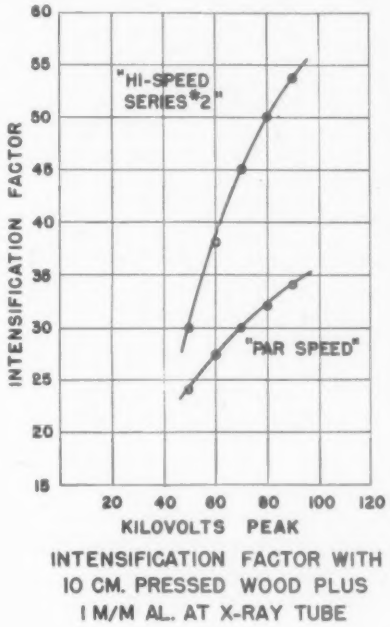


Fig. 8

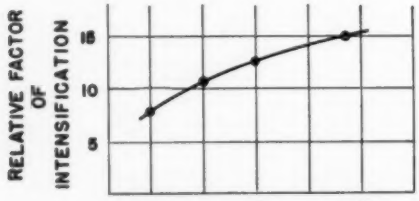
roentgenograms were studied by qualified individuals who reported their findings. The data were computed and an analysis indicated that 0.7 density is the average density of the diagnostic areas of a correctly exposed medical roentgenogram.

A comparison between two different types of intensifying screens results in two curves which demonstrate the intensification factor of each under duplicate conditions. Such a comparison is illustrated by the curves of intensification factors of calcium tungstate "Par Speed" intensifying screens and barium lead sulfate "Hi-Speed Series No. 2" intensifying screens (Fig. 8).

It is observed that at 50 kv. (peak) the intensification factor is 23 for "Par Speed" and 30 for "Hi-Speed Series No. 2" screens. Or, "Hi-Speed Series No. 2" screens are

25 per cent faster. This factor at 50 kv. (peak) will permit a reduction of 25 per cent in exposure time from that required with "Par Speed" screens. At 70 kv. (peak) the intensification factor for "Par Speed" is 30 and 45 for "Hi-Speed" screens. At this voltage the "Hi-Speed" screens become 50 per cent faster than "Par Speed" permitting a corresponding reduction in exposure time. When a comparison is made at 90 kv. (peak) the intensification factor for "Par Speed" is noted to be 35 while the factor for "Hi-Speed Series No. 2" is 57. At this kilovoltage the "Hi-Speed Series No. 2" screen becomes 63 per cent faster.

On the actual curve demonstrating intensification factors it is specified that the data were obtained while using 10 cm. of pressed wood for absorption plus 1 mm. aluminum filter at the roentgen tube. Pressed wood, aluminum and other materials are used as phantoms to simulate the absorption of roentgen radiation by a patient. The next curve illustrates the influence of the thickness of a phantom material on the intensification factor. It is noted that as the thickness of aluminum is increased the intensification factor is increased (Fig. 9).



SAMPLE CURVE - EFFECT OF ABSORPTION

FIG. 9

Sensitometric data on intensifying screens in curve form can offer reliable accurate information which is of value to the users of the screens. The evaluation of screen characteristics and their influence on exposure technique is greatly facilitated. In fact, in roentgenology sensitometry offers a concise and accurate method for determining and evaluating many of the materials used. The following may be illustrated: roentgen film characteristics, the effect of different processing solutions at various developing times, and the effect of intensifying screens on speed and contrast under various conditions. Data presented in sensitometric form can be used to evaluate the various factors influencing the quality of a roentgenogram. Sensitometric data facilitate the incorporation of improved products into the technical procedure in use by radiologists.

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DEPARTMENT OF TECHNIQUE

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A NEW ROENTGEN-RAY BEAM DIRECTOR FOR PRECISION RADIATION THERAPY*

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THE cure of primary cancer by roentgen therapy depends upon the effective delivery of a lethal tumor dose to the malignant lesion in an optimum time interval, with minimal trauma to skin and normal tissues in the path of the beam. It is now generally agreed that this is best accomplished in the patient with a deep-seated cancer by cross-firing the neoplasm with roentgen-ray beams angled through multiple skin portals. Only thus can one attain (1) the most effective tumor dose in the optimum number of treatment days, (2) homogeneous irradiation of the tumor and (3) minimal radiation effect on skin and intervening normal structures.

It is unfortunate that most roentgen therapy machines have not been equipped with devices for the precision beam angulation which must be regarded as essential in modern cross-fire roentgen therapy.

It is significant that a small error in angulation at the axis of the tube-head may throw the central beam completely beyond the limits of the tumor (Fig. 1, *A*, *B*). As the target-skin distance is increased and multiple small skin portals are introduced to improve the effectiveness of cross-fire treatment, there arises a greater and more critical need for precision angulation.

Beam angulation through empirical means or inaccurate devices is generally rewarded by failure to eradicate a radiocurable primary cancer and irreversible damage to vital normal structures.

Most roentgen therapy units now in use have no angle indicators whatsoever. A few are equipped with two widely separated conventional angle scales at the axis of rotation of the tube-head. One of these is often placed at the rear of the machine, out of direct view, and can only be read awkwardly from the side. Thus, it is usually read inaccurately because of parallax. In addition, the progressive wearing of mechanical parts and bearings in the roentgen-ray tube-head and supporting structures soon makes the accuracy of these scales questionable, unless continuous checks and readjustments are undertaken.

A new roentgen-ray beam director has been designed to overcome the objectionable features mentioned above (Fig. 2, *A*, *B*). Its action is based entirely on gravity and is therefore always accurate. It permits the roentgen-ray tube-head to be angled in two planes with a high degree of precision. These angles are reproducible for each portal from day to day in a manner not readily possible by empirical or conventional means. This has been confirmed by repeatedly checking with roentgen films exposed to the therapy beam with the patient in position for treatment.

The instrument consists of two concentric protractor rings, mounted at right

* Reviewed in the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions published by the author are the result of his own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

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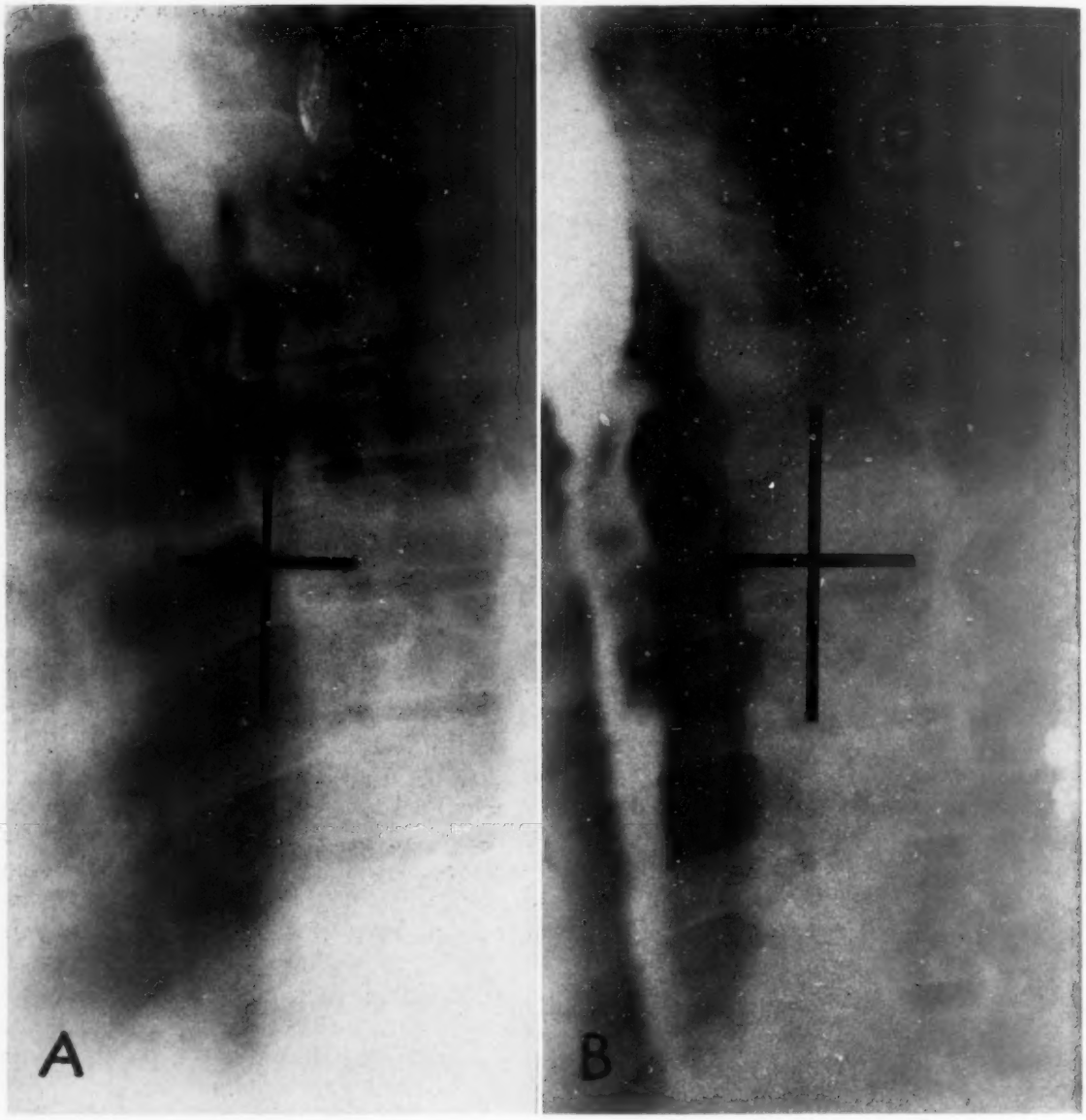

FIG. 1. Carcinoma of middle third of esophagus under treatment by cross-fire roentgen radiation, using eight skin portals 6 by 15 cm. each, target-skin distance, 50 cm. These roentgenograms were taken with the therapy beam angled through one of the skin portals, with the patient in position for treatment. (*A*) Note the excellent position of the lesion in the path of the central beam (cross-marked) when the prescribed true angle of 29 degrees is applied accurately with the beam director. (*B*) An error of only 4 degrees in tube-head angulation has been deliberately introduced. Note now the marked displacement of the central ray beyond the limits of the tumor when the improper angle of 25 degrees is employed through the same portal. Such an error is easily possible through empirical angling or inaccurate protractors.

angles to each other in vertical planes, rotating freely about horizontal axes. It is universally adaptable to any roentgen-ray machine now in use—of any type or manufacture. By means of a simple bracket it may be attached to the tube-head at any one of several points, always in the direct view of the operator (Fig. 3).

The localization of the tumor, the plotting of multiple skin portals and the prescription of the corresponding beam angles is best performed in our opinion by the

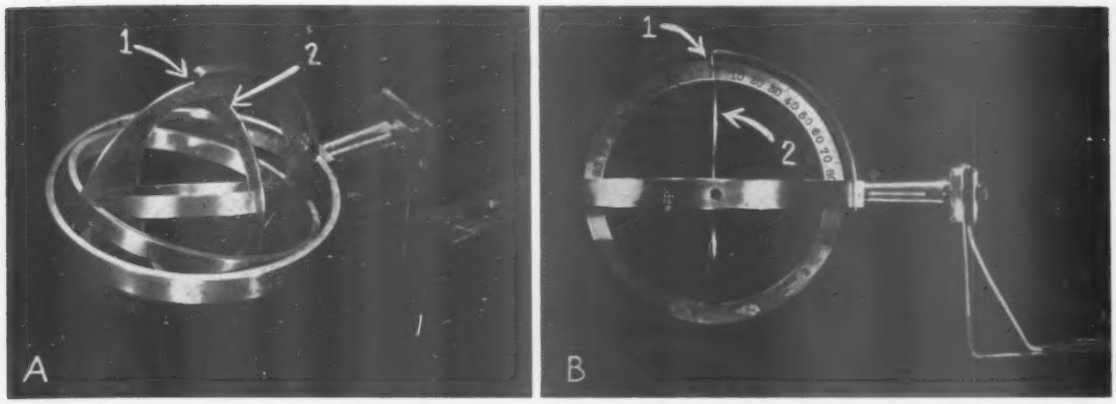

Fig. 2. (*A*) Left oblique view of beam director. Note the vertical rotating protractor rings for reading directly the angles in each of two planes. (*B*) Left lateral view. Note lead weight in lower segment of each ring for gravitation action of protractor rings.

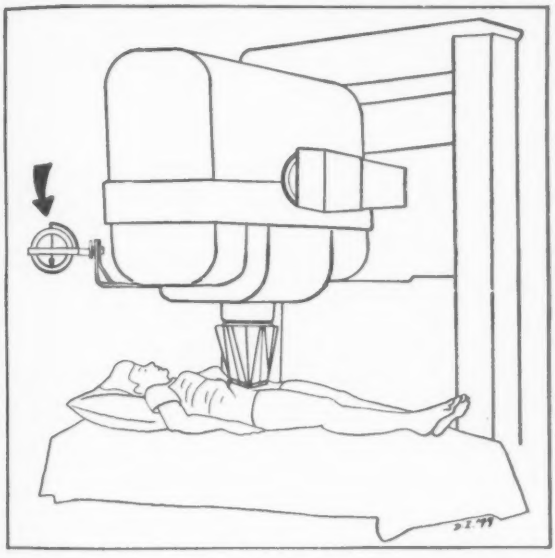

Fig. 3. Beam director attached to therapy head in direct view of the operator. Attachment may be made at any convenient point on any type of tube-head.

Fig. 4. Demy-type protractor for prescribing beam angles and corresponding skin portals for cross-fire roentgen therapy.

method described by Demy,[1] modified from Dobbie[2] (Fig. 4). This method, in combination with the beam director has been utilized in our Radiation Clinic for several years. They have become indispensable tools for the most effective treatment of deep cancers accessible to radiation therapy.

It may be of interest that the beam direc-

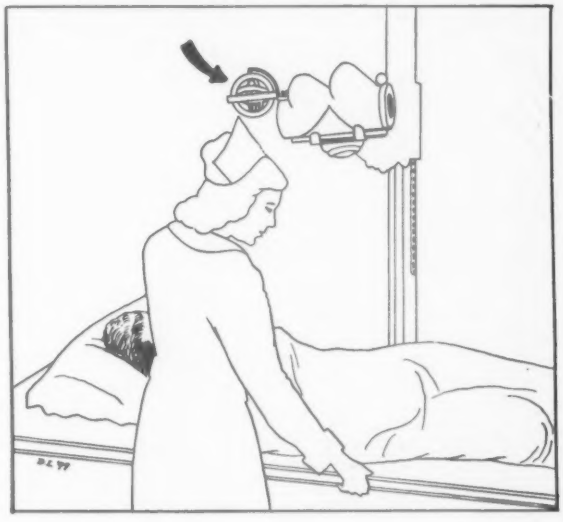

Fig. 5. Beam director attached to diagnostic roentgen-ray tube-head for precision roentgenography.

tor is easily adaptable to diagnostic roentgen-ray tube-heads (Fig. 5), whenever precision angulation is desirable in roentgenographic studies.

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Fifty-second Annual Meeting: Shoreham Hotel, Washington, D. C., September 25–28, 1951.

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Thirty-Third Annual Meeting: Hotel Claridge, Atlantic City, N. J., June 7–9, 1951.

EDITORIALS

LONGITUDINAL GROWTH OF THE HUMAN VERTEBRA

IN 1921 Scheuermann called attention to a group of cases occurring in the adolescent period which exhibited a dorsal kyphosis with wedging of the dorsal vertebrae and, observing a similarity to Legg-Calvé-Perthes' disease or osteochondritis of the hip as well as a similarity to Köhler's disease of the scaphoid, he called the condition "osteochondritis deformans juvenilis," a condition with which all roentgenologists are familiar, but since Scheuermann's classical paper on this disease manifestation it has become popularly known as Scheuermann's disease. With the publication of his paper concerning the anteroposterior deformities of the vertebral bodies in the adolescent period, particularly in the dorsal and upper lumbar region, Scheuermann added greatly to our knowledge of deformities of the spine.[1]

Scheuermann based his observations on the roentgenologic findings in the vertebral bodies and he postulated that the deformity which he observed in the adolescent was due to an aseptic necrosis—an epiphysitis of the ring epiphysis which is undergoing marked ossification at about this age. It had been observed by Köhler that, at the time of puberty, namely about the fourteenth year of life, there appears at the upper and lower anterior edges of the vertebral bodies a small triangular roentgen shadow representing the first signs of the epiphyseal rings. Köhler observed these ring-shaped formations to gradually project farther back, thinning out in a fine line and assuming greater thickness again at the posterior edges of the vertebral bodies. This so-called "epiphyseal ring" apparently remains separated from the body of the vertebrae until the time of fusion which, according to some observers, occurs about the twenty-second to the twenty-fifth year, at which time the longitudinal growth of the vertebral bodies is concluded. Scheuermann, in his cases, found that the vertebral bodies were lower in front and the epiphyseal disc appeared broad and irregular. The contours of the epiphyses themselves appeared irregular and fragmented, and in the diseased vertebra were blurred and indistinct. Quite naturally, Scheuermann inferred from the analysis of his cases that the primary effect of the condition was disturbance of the epiphyseal growth. In later stages of the disease it was found that the epiphyseal ring again assumed more definite contours, that its irregular fragmentation disappeared and that it became solid, resulting in a wedge-shaped deformity of the involved vertebra.

As a result of Scheuermann's observation, there has arisen considerable controversy as to the function of the so-called "ring epiphysis." Schmorl, among others, having examined at autopsies numerous spines of adolescent patients with juvenile kyphosis, found large nuclear prolapses into the spongiosa through the cartilage plates, and furthermore that these prolapses were in a location which is usually the one where some of the chondrification gaps have occurred due to degenerated vessels producing weak points. Schmorl, as well as others, raised the point as to whether or not the ring epiphysis has anything to do with the growth in height of the vertebral bodies. Another observer, namely Ehrenhaft,[2] believes that the growth in the height

[1] Steindler, Arthur. Diseases and Deformities of the Spine and Thorax. C. V. Mosby Co., St. Louis, 1929.

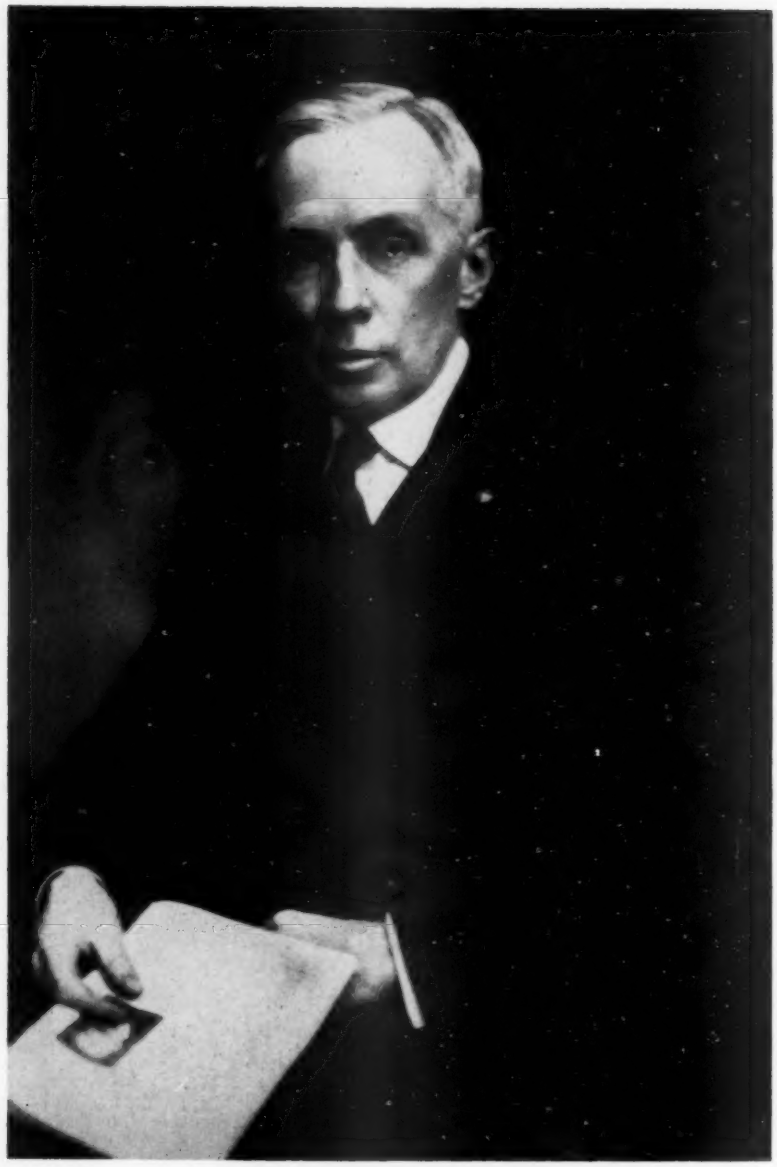
[2] Ehrenhaft, J. L. Development of the vertebral column as related to certain congenital and pathological changes. *Surg., Gynec. & Obst.*, 1943, *76*, 282–292.

of the vertebral bodies is exclusively a function of the cartilage plate which is central to the ring epiphysis and underlies the rim edge proper. Ehrenhaft's observations led him to the conclusion that nuclear prolapses of juvenile kyphosis often occur all along the vertebral bodies of the lower thoracic and upper lumbar region and that the uneven growth in height of individual vertebrae tends to retard the growth anteriorly where the increased pressure load is concentrated and that more normal growth occurs posteriorly. Thus, the relative wedging of the vertebral bodies seen in Scheuermann's disease is secondary to the improper mechanical function of the degenerating narrowed intervertebral disc and in this way the kyphotic deformity results. The fragmentation of the anterior portion of the ring epiphysis which the roentgenologist observes in the roentgenograms in patients exhibiting Scheuermann's disease results from improper motion, abnormal pressure relationship, and shearing stress put upon anterior annulus fibers and the unfused ring epiphysis.

A considerable literature has arisen concerning the longitudinal growth of the human vertebra and the controversy dates from the work of Scheuermann, Schmorl and others and in spite of the considerable literature concerning this moot question, the problem of longitudinal growth of the vertebral body in the human is still a controversial subject. Quite recently, Bick and Copel[3] have entered the controversy in an attempt to settle the problem. Their observation concerning the longitudinal growth of the human vertebra is based upon fresh autopsy material in which death was known to have occurred from causes unrelated to pathological changes in the musculoskeletal system. Their specimens which they analyzed ranged from that of an 8 cm. fetus—namely, a fetus of about fourteen menstrual weeks—to that of a female twenty-three years old. In the anaylsis of their specimens they concluded that the body of the human vertebra grows, as does the diaphysis of a long bone, with true proximal and distal epiphyseal plates, and if this is so, the body of the human vertebra is subject to the same deforming factors which influence the growth of long bones elsewhere in the body. In a discussion of their analysis they state that their anatomical sections were not cut to show best the histology of the roentgenographically prominent structures lying on the cephalic and caudal surfaces of the vertebral body, but from a study of their material they confirmed Schmorl's views that the so-called "epiphyseal ring" of the vertebra is misnamed, and state that the label should be stricken from scientific terminology. They are emphatic in the statement that "The ring is not an epiphysis and takes no active part in the growth of the vertebral body. It is primarily a cartilaginous ring, which is ossified separately." They suggest that this be called the "vertebral ring" and they emphasize that this structure bears no relationship to epiphyseal growth; that this vertebral ring lies outside the metaphyseal area and fuses with the body when longitudinal growth is completed. They are led to believe that this vertebral ring acts precisely as do apophyses elsewhere in the skeleton, that it is a peripheral structure and, except at the rim of the vertebral body, does not lie in the axis of its longitudinal growth. Its function, the authors conclude, is still open to question. But they are emphatic in their conclusions that the vertebral ring, often observed in the roentgenograms of growing vertebrae, is an apophysis rather than an epiphysis, and that it certainly plays no part in the longitudinal growth of the vertebral body.

Since Bick and Copel admit that their anatomical sections were not cut to show best the histology of the roentgenographically prominent structures lying on the cephalic and caudal surfaces of the vertebral body, namely the so-called "epiphyseal ring," and since there is considerable controversy regarding this apparently important structure in health as well as in disease, are there not indications for anatomical studies dealing primarily with this structure of the vertebral body?

[3] Bick, E. M., and Copel, J. W. Longitudinal growth of the human vertebra. *J. Bone & Joint Surg.*, Oct., 1950, *32-A*, 803–814.



PERCY BROWN
1875–1950

DR. PERCY BROWN,* a martyr to science through the roentgen rays and a past president of the American Roentgen Ray Society, died at his home in Egypt, Massachusetts, on October 8, 1950, at the age of seventy-four.

Dr. Brown was born in Cambridge, Massachusetts, a son of Isaac Henry and Mary Elizabeth (Kennedy) Brown. He was a graduate of Browne and Nichols School and received his pre-medical education at the Lawrence Scientific School,

* He was christened Percy Emerson Brown; the first name for the Pierces of New Hampshire (Franklin Pierce *et al.*) and the second for his paternal family. Emerson, Ralph Waldo, was a cousin of his grandmother. When Percy started in practice, he found to his dismay that there was a Percy G. Brown, a homeopath, whose letters, bills and notices he often received. So, to avoid confusion, Percy decided to drop his middle name. Also he thought that the short name followed by Brown was more suitable for professional use. This he did by court order. So his name, at the time of his death, was Percy Brown.

now the Engineering Department of Harvard University. He was graduated from the Harvard Medical School in the class of 1900, and two years later completed his internship at the Boston Children's Hospital. It was during this period that he became interested in the roentgen rays as an aid to diagnosis in disease. Röntgen had announced his discovery in December, 1895. The important part that this new ray was to take in medicine was evident to only a few gifted individuals.

No doubt Dr. Brown's undergraduate training in mathematics and physics was a factor of considerable importance in his ability to visualize the future of the infant science. As in everything he did, once he had convinced himself of its importance, he put everything he had into it. He gave up his practice in other branches of medicine and was probably the first physician in Boston to confine his work entirely to the use of the roentgen ray.

In 1903, he organized roentgen-ray departments at the Children's Hospital and at the Carney Hospital, and in the same year was made "Assistant in the Use of the Roentgen Ray" at the Harvard Medical School, to become the first teacher of this subject at Harvard. At about the same time (1904) he opened the first private office in Boston for the examination of patients with the roentgen rays.

Dr. Brown was a cultured Bostonian of the old school. His educational and ethical standards did much to give the new specialty recognition in Boston medical circles. It is to such men as Percy Brown that the specialty owes its very existence. It has taken fifty years to raise the standards of training for radiologists to that which he set in 1903.

Dr. Brown was an early member of the American Roentgen Ray Society and its President in 1911. He was a Fellow of the American College of Physicians, a Fellow of the American College of Radiology, a member of the New York Roentgen Society, the Philadelphia Roentgen Society, the New England Roentgen Ray Society, the original Roentgen Society of London, and the Deutsche Röntgen-Gesellschaft of Berlin. He was also a member of the American Association for the Advancement of Science, the American Medical Association, the Medical Society of the State of New York, and the Massachusetts Medical Society.

Although exposure to the roentgen rays during his early work had resulted in some injury to his skin, he promptly entered the Medical Corps of the U.S. Army at the beginning of the first World War; was commissioned a Major and served with Base Hospital No. 5 in France. The treatment of the wounded during this war required an enormous amount of fluoroscopic work, often done under conditions which gave inadequate protection to the radiologist; and when Dr. Brown returned to civilian life in 1919 his old injuries were considerably aggravated. He did not return to the private practice of radiology but became associated with various large clinics as Radiologist-in-chief. His longest service was at St. Luke's Hospital in New York City. During these years, the deleterious effect of the roentgen rays upon his skin gradually increased until he was forced to give up active practice.

During his long career, Dr. Brown designed several pieces of apparatus useful in the operation of the roentgen rays. He wrote many important articles on the subject of his specialty which were published in the medical journals of his time. He was the author of a biographical monograph on "American Martyrs to Science through the Roentgen Rays" to which long list his death adds another name. He also contributed the chapter on Radiologic Diagnosis for the book. "The Science of Radiology." He received many honors, bestowed upon him in recognition of his professional achievements, including the Gold Medal of the Radiological Society of North America.

In 1904, he married the former Bernice Mayhew of Cambridge, Massachusetts who survives him. Her untiring devotion, with the help which his friend and physician, Dr. Ernest Daland, was able to give, made it possible for him to maintain his unusual

courage and cheerfulness through long years of suffering. During this time, he underwent more than fifty operations, all of which were for the control of cancer, necessitating the removal of various parts of his hands and face. He died quietly of a cardiac ailment without evidence of generalized cancer.

Percy Brown was loved by all who knew him. He leaves many sincere friends in Boston and in the American Roentgen Ray Society. He also leaves a legacy of professional achievement as well as an example of great courage.

GEORGE W. HOLMES, M.D.

TRIBUTE TO PERCY BROWN WRITTEN TO DR. HOLMES

By THOMAS R. GOETHALS, M.D., of Boston

PERCY BROWN and I never knew each other until we served together in Base Hospital No. 5 during World War I. Although he was the Chief of the X-ray Service and I a very junior ward officer, the discrepancy between our professional standings and our respective ages did not inhibit the development of a very warm friendship between us which lasted as long as Percy lived.

There are few less qualified than I to write of Percy's professional career; that is a matter of record to which I can contribute little, if anything. To be sure, I admired him for his pioneer accomplishments with the roentgen ray, but what drew me to him were his personal qualities, especially his humor, his courage and his unfailing consideration for others.

Percy's humor was blended into the warp and woof of his character. There were few situations or occurrences in the world, whether or not he was concerned in them, from which he did not portray a humorous side. It was a privilege to be with him in his associations with our French and British allies in 1917 and 1918. His humor always rang true, in that it never lacerated, wounded or even stung its subject. It was the humor of Mark Twain as distinct from the wit of Bernard Shaw. It sustained his spirit to the end, and I am sure that the night before he died, as his devoted wife was reading aloud to him, he threw back his head more than once and laughed contagiously at some reference in the book which she was reading.

He possessed a strong sense of fair play and was quick to resent injustice. A typical example of this arose one day in France, when Percy, working hard in the cubbyhole assigned him, was visited by a temperamental surgeon who voiced disapproval of an x-ray plate which had been sent him. The day was hot, the work load heavy. Percy listened to a rather forceful criticism of his work. Quietly he said, "Let me see the plate, please." He looked at it for a moment, then allowed the plate to splinter on the ground. His hackles rose. "There, Major, maybe that will satisfy you!" The surgeon left and was quoted later as saying, "Percy Brown is too hot for me to handle." He was right. No one could "handle" Percy!

Percy feared the opinion of no man, and was expert in detecting pretense behind a false front. I am told that at society meetings his discussions of work of others were always couched in language which gave generous credit where credit was due, but which, if it expressed criticism or disagreement, did so in words which left no sting behind. I am convinced that this is true, because of his innate consideration for others.

His courage during his later years was inspiring. As one of the last, if not the last, of the "old contemptibles" in x-ray he had seen one friend after another yield to the same ravages which afflicted him. Many years ago he said to me, "There's one thing about a skin cancer—it gives you warning, like a rattlesnake." This was after one of his countless bouts with the surgeons! Notwithstanding this I never once heard

him complain of his infirmities, of the discomfort and pain caused by them, nor of the physical limitations which confined him to a bed-and-chair existence during his last years.

Last but not least I admired him for his kindliness and consideration toward other people. My boys loved him as I did, for he had a way with the young that endeared him to them. All who knew him recognized his generous spirit. The world is richer for his having lived in it, and his passing leaves a void in the lives of many of us that will never be filled.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

MEETINGS OF ROENTGEN SOCIETIES*

UNITED STATES OF AMERICA

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. Barton R. Young, Germantown Hospital, Philadelphia 44, Pa. Annual meeting: Shoreham Hotel, Washington, D.C., Sept. 25–28, 1951.

AMERICAN RADIUM SOCIETY
Secretary, Dr. J. E. Wirth, U. S. Marine Hospital, Baltimore, Md. Annual meeting: Hotel Claridge, Atlantic City, N. J., June 7–9, 1951.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. D. S. Childs, 713 E. Genesee St., Syracuse 2, N. Y., Annual meeting: Palmer House, Chicago, Ill., Dec. 10–15, 1950.

AMERICAN COLLEGE OF RADIOLOGY
Executive Secretary, William C. Stronach, 20 N. Wacker Drive, Chicago 6.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. P. C. Hodges, 950 E. 59th St., Chicago, Ill.

ALABAMA RADIOLOGICAL SOCIETY
Secretary, Dr. W. W. Anderson, Tuscaloosa, Ala. Meets time and place Alabama State Medical Association.

ARIZONA ASSOCIATION OF PATHOLOGISTS AND RADIOLOGISTS
Secretary, Dr. R. Lee Foster, 507 Professional Bldg., Phoenix, Ariz. Two regular meetings a year. The annual meeting at time and place of State Medical Association and interim meeting six months later.

ARKANSAS RADIOLOGICAL SOCIETY
Secretary, Dr. Fred Hames, 511 National Bldg., Pine Bluff, Ark. Meets every three months and also at time and place of State Medical Association.

ATLANTA RADIOLOGICAL SOCIETY
Secretary, Dr. T. F. Leigh, Emory Univ. Hospital, Emory University, Ga. Meets monthly, except during three summer months, on second Friday evening.

BROOKLYN ROENTGEN RAY SOCIETY
Secretary, Dr. J. J. Daversa, 345 75th St., Brooklyn, N. Y. Meets monthly fourth Tuesday, Oct. through April.

BUFFALO RADIOLOGICAL SOCIETY
Secretary, Dr. Mario C. Gian, 610 Niagara St., Buffalo, N. Y. Meets second Monday evening each month, October to May inclusive.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. Dwight V. Needham, 608 E. Genesee St., Syracuse N. Y. Meets January, May, November.

CENTRAL OHIO RADIOLOGICAL SOCIETY
Secretary, Dr. F. A. Riebel, 15 West Goodale St., Columbus, Ohio. Meets at 6:30 P.M. on second Thursday of October, December, February, April, and June at Columbus Athletic Club, Columbus, Ohio.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. B. D. Braun, 6 N. Michigan Ave., Chicago 2, Ill. Meets second Thursday of each month, October to April inclusive at the University Club.

CINCINNATI RADIOLOGICAL SOCIETY
Secretary, Dr. E. C. Elsey, 927 Carew Tower, Cincinnati 2, Ohio. Meets last Monday of each month, September to May, inclusive.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. J. R. Hannan, 10515 Carnegie Ave., Cleveland 6, Ohio. Meetings at 6:45 P.M. on fourth Monday of each month from October to April.

COLORADO RADIOLOGICAL SOCIETY
Secretary, Dr. Paul E. RePass, 306 Republic Bldg., Denver 2, Colo. Meets third Friday of each month at University of Colorado Medical Center or at Denver Athletic Club.

CONNECTICUT VALLEY RADIOLOGIC SOCIETY
Secretary, Dr. E. W. Godfrey, 1676 Boulevard, West Hartford, Conn. Meets second Friday Oct. and April.

DALLAS-FORT WORTH ROENTGEN STUDY CLUB
Secretary, Dr. X. R. Hyde, Medical Arts Bldg., Fort Worth, Texas. Meets in Dallas on odd months and in Fort Worth on even months, on third Monday, 7:30 P.M.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. J. C. Cook, Harper Hospital. Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

EAST BAY ROENTGEN SOCIETY
Secretary, Dr. Dan Tucker, 434-30th St., Oakland 9, Calif. Meets first Thursday each month at Peralta Hospital, Oakland.

FLORIDA RADIOLOGICAL SOCIETY
Secretary, Dr. T. H. Lipscomb, 30 W. Beaver St., Jacksonville, Fla. Meets twice annually, in the spring with the annual State Society meeting, and in the fall.

GEORGIA RADIOLOGICAL SOCIETY
Secretary, Dr. R. C. Pendergrass, Americus, Ga. Meets in mid-winter and at annual meeting of Medical Association of Georgia in the spring.

GREATER MIAMI RADIOLOGICAL SOCIETY
Secretary, Dr. David Kirsh, 712 duPont Bldg., Miami 32, Florida. Meets last Wednesday of each month at 8:00 P.M. at Veterans Administration Regional Office.

HOUSTON X-RAY CLUB
Secretary, Dr. Curtis H. Burge, 3020 San Jacinto St., Houston 4, Texas. Meets fourth Monday each month.

RADIOLOGICAL SOCIETY OF KANSAS CITY
Secretary, Dr. Arthur B. Smith, 800 Argyle Bldg., Kansas City, Mo. Meets third Thursday of each month.

ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. Wm. DeHollander, St. John's Hospital, Springfield, Ill. Meets three times a year.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. William M. Loehr, 712 Hume-Mansur Bldg., Indianapolis 4. Meets second Sunday in May.

IOWA X-RAY CLUB
Secretary, Dr. Arthur W. Erskine, 326 Higley Bldg., Cedar Rapids, Iowa. Luncheon and business meeting during annual session of Iowa State Medical Society.

KANSAS RADIOLOGICAL SOCIETY
Secretary, Dr. Anthony F. Rossitto, Wichita Hospital, Wichita, Kan. Meets annually with State Medical Society.

KENTUCKY RADIOLOGICAL SOCIETY
Secretary, Dr. E. L. Pirkey, Louisville General Hospital, Louisville 2, Ky. Meets monthly on second Friday at Seelbach Hotel, Louisville.

KINGS COUNTY RADIOLOGICAL SOCIETY
Secretary, Dr. Marcus Wiener, 1430-48th St., Brooklyn, N. Y. Meets Kings County Med. Soc. Bldg. monthly on fourth Thursday, October to May, 8:45 P.M.

LOS ANGELES RADIOLOGICAL SOCIETY
Secretary, Dr. Wybren Hiemstra, 1414 S. Hope St., Los Angeles 15, Calif. Meets second Wednesday each month at Los Angeles County Medical Assn. Building.

LOUISIANA RADIOLOGICAL SOCIETY
Secretary, Dr. J. R. Anderson, 1130 Louisiana Ave., Shreveport. Meets annually during Louisiana State Medical Society Meeting.

* Secretaries of societies are requested to send timely information promptly to the Editor.

Maine Radiological Society
Secretary, Dr. C. F. Miller, Central Maine General Hospital, Lewiston, Maine.

Miami Valley Radiological Society
Secretary, Dr. G. A. Nicoll, 134 Apple St., Dayton, Ohio. Meets second Friday of fall and winter months.

Michigan Association of Roentgenologists
Secretary, Dr. R. D. McDuff, 220 Genesee Bank Bldg., Flint 3, Mich.

Mid-Hudson Radiological Society
Secretary, Dr. J. W. Walton, Horton Memorial Hospital, Middletown, N. Y. Meets 8:30 P.M., fourth Tuesday each month, Sept. to May.

Milwaukee Roentgen Ray Society
Secretary, Dr. T. J. Pfeffer, 839 N. Marshall St., Milwaukee 2, Wis. Meets monthly on second Monday at University Club.

Minnesota Radiological Society
Secretary, Dr. L. A. Nash, 572 Lowry Medical Arts Bldg., St. Paul 2, Minn. Meets three times annually, once at time of State Med. Assn., and in spring and fall.

Nebraska Radiological Society
Secretary, Dr. J. E. Downing, 816 Medical Arts Bldg., Omaha, Nebr. Meets fourth Thursday of each month at 6 P.M. at Omaha or Lincoln.

New England Roentgen Ray Society
Secretary, Dr. L. L. Robbins, Massachusetts General Hospital, Boston, Mass. Meets monthly on third Friday, Harvard Club.

New Hampshire Roentgen Ray Society
Secretary, Dr. A. C. Johnston, Elliott Community Hospital, Keene, N. H. Meets four to six times yearly.

New York Roentgen Society
Secretary, Dr. J. L. Olpp, 49 Ivy Lane, Tenafly, N. J. Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

North Carolina Radiological Society
Secretary, Dr. J. E. Hemphill, 1420 E. Fifth St., Charlotte 4, N. C. Meets in May and October.

North Dakota Radiological Society
Secretary, Dr. C. O. Heilman, 807 Broadway, Fargo. Meetings by announcement.

Northern California Radiological Club
Secretary, Dr. C. W. Wauters, 701 High St., Auburn, Calif. Meets at dinner last Monday, every second month, except June, July and August.

Ohio State Radiological Society
Secretary, Dr. E. C. Elsey, 927 Carew Tower, Cincinnati 2, Ohio.

Oklahoma State Radiological Society
Secretary, Dr. W. E. Brown, 21st & Xanthus, Tulsa 4, Okla. Three regular meetings annually.

Oregon Radiological Society
Secretary, Dr. C. T. Jessell, 214 Medical-Dental Bldg., Portland 5, Oregon. Meets monthly 2nd Wednesday, 8:00 P.M.

Orleans Parish Radiological Society
Secretary, Dr. Joseph V. Schlosser, Charity Hospital, New Orleans 13, La. Meets first Tuesday of each month.

Pacific Northwest Radiological Society
Secretary, Dr. S. J. Hawley, 1320 Madison St., Seattle 4, Wash. Meets annually in May.

Pacific Roentgen Society
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association.

Pennsylvania Radiological Society
Secretary, Dr. J. M. Converse, 416 Pine St., Williamsport.

Philadelphia Roentgen Ray Society
Secretary, Dr. G. P. Keefer, American Oncologic Hospital, Philadelphia 4, Pa. Meets first Thursday each month October to May, at 8:00 P.M., in Thomson Hall, College of Physicians.

Pittsburgh Roentgen Society
Secretary Dr. E. J. Euphrat, 3500 Fifth Ave., Pittsburgh 13, Pa. Meets 6:30 P.M. at Webster Hall Hotel on second Wednesday each month, October to May inclusive.

Queens Roentgen Ray Society
Secretary, Dr. J. E. Goldstein, 88-29 163rd St., Jamaica 3, N. Y. Meets fourth Monday of each month except during the summer.

Radiological Section, Baltimore Medical Society
Secretary, Dr. Harry A. Miller, 2452 Eutaw Place, Baltimore. Meets third Tuesday each month, Sept. to May.

Radiological Section, Connecticut Medical Society
Secretary, Dr. Fred Zaff, 135 Whitney Ave., New Haven, Conn. Meets bimonthly on second Wednesday.

Radiological Section, District of Columbia Medical Society
Secretary, Dr. K. C. Corley, 1835 Eye St., N. W., Washington, D. C. Meets Medical Society Auditorium, third Thursday, Jan., March, May, Oct. at 8:00 P.M.

Radiological Section, Southern Medical Association
Secretary, Dr. Roy G. Giles, Temple, Texas.

Radiological Society of New Jersey
Secretary, Dr. Peter Gianquinto, 685 High St., Newark, N. J. Meets annually at Atlantic City at time of State Medical Society and mid-winter at Elizabeth, N. J.

Rochester Roentgen Ray Society, Rochester, N. Y.
Secretary, Dr. A. V. Winchell, 40 Meigs St., Rochester, N. Y. Meets monthly on last Monday from September through May, 8 P.M. at Strong Memorial Hospital.

Rocky Mountain Radiological Society
Secretary, Dr. Maurice D. Frazer, 1037 Stuart Bldg., Lincoln, Nebr.

St. Louis Society of Radiologists
Secretary, Dr. H. R. Senturia, Pasteur Medical Building, St. Louis, Mo. Meets fourth Wednesday each month, except June, July, August, and September.

San Diego Roentgen Society
Secretary, Dr. R. F. Niehaus, 1831 Fourth Ave., San Diego, Calif. Meets monthly, first Wednesday at dinner.

Section on Radiology, California Medical Association
Secretary, Dr. D. R. MacColl, 2007 Wilshire Blvd., Los Angeles 5, Calif.

Section on Radiology, Illinois State Medical Society
Secretary, Dr. Harold L. Shinall, St. Joseph's Hospital, Bloomington, Ill.

Shreveport Radiological Club
Secretary, Dr. R. W. Cooper, Charity Hospital, Shreveport, La. Meets monthly on third Wednesday, at 7:30 P.M., September to May inclusive.

South Carolina X-Ray Society
Secretary, Dr. S. H. Fisher, 107 E. North St., Greenville, S. C. One meeting with South Carolina Medical Association in May, others arranged by President.

Tennessee Radiological Society
Secretary, Dr. J. M. Frère, 707 Walnut St., Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
Secretary, Dr. R. P. O'Bannon, 650 Fifth Ave., Fort Worth 4, Texas. Meets Galveston, Jan 19 and 20, 1951.

University of Michigan Department of Roentgenology Staff Meeting
Meets each Monday evening from September to June, at 7 P.M. at University Hospital.

University of Wisconsin Radiological Conference
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis. Meets first and third Thursdays 4:00 to 5:00 P.M., September to May inclusive. Room 203, Service Memorial Institute, 426 N. Charter St., Madison.

Utah State Radiological Society
Secretary, Dr. Angus K. Wilson, 343 S. Main St., Salt Lake City 1, Utah. Meets third Wednesday in September, November, January, March and May.

VIRGINIA RADIOLOGICAL SOCIETY
Secretary, Dr. P. B. Parsons, Norfolk General Hospital, Norfolk, Va. Meets annually in October.

WASHINGTON STATE RADIOLOGICAL SOCIETY
Secretary, Dr. R. C. Kiltz, 705 Medical-Dental Bldg., Everett, Wash. Meets fourth Monday each month, October through May, College Club, Seattle.

WISCONSIN RADIOLOGICAL SOCIETY
Secretary, Dr. Irving I. Cowan, 425 E. Wisconsin Ave., Milwaukee 2, Wis. Special meetings held during year; annual meeting each spring at Madison, Wis.

X-RAY STUDY CLUB OF SAN FRANCISCO
Secretary, Dr. M. A. Sisson, 450 Sutter St., San Francisco, 8, Calif. Meets Jan. to July, Lane Hall, Stanford Univ. Hospital; July to Dec. San Francisco Hospital.

CUBA, MEXICO AND CENTRAL AMERICA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA
President, Dr. J. Manuel Viamonte, Hospital Mercedes, Habana, Cuba. Meets monthly in Habana.

SOCIEDAD MEXICANA DE RADIOLOGIA Y FISIOTERAPIA
General Secretary, Dr. D. P. Cossio, Marsella No. 11, Mexico, D. F. Meets first Monday of each month.

SOCIEDAD RADIOLÓGICA PANAMEÑA
Secretary, Dr. L. Arrieta Sanchez, Apartado No. 86 Panama, R. de P. Meets monthly in a department of radiology of a local hospital, chosen at preceding meeting.

BRITISH EMPIRE

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY
Ordinary meeting, on the Thursday preceding the third Friday, October to May at 8:15 P.M.
Medical Members' meeting, on third Friday in each month at 5:00 P.M., 32 Welbeck St., London, W 1.

FACULTY OF RADIOLOGISTS
Honorary Secretary, Dr. J. F. Bromley, 45, Lincoln's Inn Fields, London, W.C.2, England.

SECTION OF RADIOLOGY OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets third Friday each month at 4:45 P.M. at the Royal Society of Medicine, 1 Wimpole St., London.

CANADIAN ASSOCIATION OF RADIOLOGISTS
Honorary Secretary-Treasurer, Dr. Jean Bouchard, Suite 305, 1555 Summerhill Avenue, Montreal 26, Que. Meetings January and June.

SECTION OF RADIOLOGY, CANADIAN MEDICAL ASSOCIATION
Secretary, Dr. C. M. Jones, Inglis St., Ext. Halifax, N. S.

SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES
Secretary, Dr. Origéne Dufresne, 4120 Ontario St., East, Montreal, P. Q.

AUSTRALIAN AND NEW ZEALAND ASSOCIATION OF RADIOLOGISTS
Honorary Secretary, Dr. Alan R.Colwell, 135 Macquarie St., Sydney, N.S.W.
Honorary Secretaries, State Branches:
New South Wales, Dr. E. W. Frecker, 135 Macquarie St., Sydney.
Victoria, Dr. T. L. Tyrer, 3 Lockerbie Court, East St. Kilda.
Queensland, Dr. J. Adam, 131 Wickham Terrace, Brisbane.
South Australia, Dr. R. de G. Burnard, 170 North Terrace, Adelaide.
Western Australia, Dr. A. M. Nelson, 179-B St. Georges Terrace, Perth.
New Zealand, Dr. E. G. Lynch, 12 Bolton St., Wellington.

SOUTH AMERICA

ASOCIACION ARGENTINA DE RADIOLOGIA
Secretary, Dr. Lidio G. Mocsa, Avda. Gral Paz 151, Córdoba, Argentina. Meetings held monthly.

SOCIEDAD ARGENTINA DE RADIOLOGIA, JUNTA CENTRAL, BUENOS AIRES
Secretary, Dr. Oscar F. Noguera, Santa Fe 1171, Buenos Aires. Meetings are held monthly.

SOCIEDAD ARGENTINA DE RADIOLOGIA, FILIAL DEL LITORAL, SEDE, ROSARIO
President, Dr. Francisco P. Cifarelli. Meets monthly second Wednesday, 19 ha 663 Italia St., Rosario, Santa Fe.

SOCIEDAD ARGENTINA DE RADIOLOGIA, FILIAL DEL SUR, SEDE, LA PLATA
President, Prof. Dr. Jose P. Uslenghi, La Plata. Meets monthly.

SOCIEDAD ARGENTINA DE RADIOLOGIA, FILIAL DEL CENTRO, SEDE, CORDOBA
President, Prof. Dr. David L. Caro, Cerro 86, Cordoba. Meets monthly.

SOCIEDAD ARGENTINA DE RADIOLOGIA, FILIAL DEL NORTE, SEDE, TUCUMAN
President, Dr. Julio Mendez Valladares, Rivadavia 358, Tucuman. Meets monthly.

SOCIEDAD ARGENTINA DE RADIOLOGIA, FILIAL DE CUYO, SEDE, MENDOZA.
President, Dr. J. A. Orfila, Hospital Central, Mendoza. Meets monthly.

SOCIEDADE BRASILEIRA DE RADIOLOGIA MEDICA
Secretary, Dr. Nicola Caminha, Av. Mem de Sa, Rio de Janeiro, Brazil. Meets monthly, except during January, February and March.

SOCIEDADE BRASILEIRA DE RADIOTERAPIA
Secretary, Dr. Oscar Rocha von Pfuhl, Av. Brigadeiro Luiz Antonio, 644 São Paulo, Brazil. Meets monthly on second Wednesday at 9 P.M. in São Paulo at Av. Brigadeiro Luiz Antonio, 644.

SOCIEDAD COLOMBIANA DE RADIOLOGIA
Secretary, Dr. Alberto Torres Focke, Av. 34, No. 17-34, Bogota, Colombia. Meets last Wednesday of each month.

SOCIEDAD PERUANA DE RADIOLOGIA
Secretary, Dr. Julio Bedoya Paredes, Apartado, 2306, Lima, Peru. Meets monthly except during January, February and March, at Asociación Médica Peruana "Daniel A. Carrión," Villalta, 218, Lima.

SOCIEDAD DE RADIOLOGICA, CANCEROLOGIA Y FISICA MEDICA DEL URUGUAY
Secretary, Dr. Arias Bellini, Av. Agraciada 1464, Piso 13, Montevideo, Uruguay.

CONTINENTAL EUROPE

SOCIÉTÉ BELGE DE RADIOLOGIE
General Secretary, Dr. S. Masy, 111 Avenue des Allies, Louvain, Belgium. Meets monthly, second Sunday at Maison des Médecins, Brussels.

CESKOSLOVENSKÁ SPOLEČNOST PRO RÖNTGENOLOGII A RADIOLOGII V PRAZE
Secretary, Dr. Roman Bláha, Praha XII, stát. nemocnice, Czechoslovakia. Meets monthly except during July, August, and September. Annual general meeting.

POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. L. Zgliczynski, 59 Nowogrodzka St., Warsaw, Poland.

GDANSK SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. A. Smigielska, Akademia Lekarska, Gdansk. Meets monthly last Sunday at 10:30, X-Ray Dept., Akademia Gdansk.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. L. Zgliczynski, 59 Nowogrodzka St., Warsaw, Poland. Meets monthly.

SOCIETATEA ROMANA DE RADIOLOGIE SI ELECTROLOGIE
Secretary, Dr. Oscar Meller, Str. Banual Mărăcine, 30, S. I., Bucuresti, Roumania. Meets second Monday in every month with the exception of July and August.

All-Russian Roentgen Ray Association, Leningrad. USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson. Meets annually.

Scandinavian Roentgen Societies
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association.

Sociedad Espanola de Radiologia y Electrologia
Secretary, Dr. J. Martin-Crespo, Fuencarral, 7. Madrid, Spain. Meets monthly in Madrid.

Schweizerische Röntgen-Gesellschaft (Société Suisse de Radiologie)
Secretary, Dr. Max Hopf, Effingerstrasse 47, Bern, Switzerland.

Societa Italiana di Radiologia Medica
Secretary Prof. Mario Ponzio, Ospedale Mauriziano. Torino, Italy. Meets biannually.

CONFERENCE OF TEACHERS OF CLINICAL RADIOLOGY

The Eighteenth Annual Conference of Teachers of Clinical Radiology will be held at the Palmer House in Chicago, Illinois, on February 10, 1951. All radiologists are invited to attend.

The subject of the 1951 Conference, "Radiologic Defense," is currently of extreme importance. The radiological aspects of civil defense in the event of atomic attack are the legitimate concern of every radiologist and every radiologist has an obligation to possess knowledge of the subject.

The program of the Conference follows:

Morning Session

9:00 A.M.—12:00 M.

Chairman, Dr. Robert R. Newell, Chairman Commission on Radiological Units, Standards, and Protection.
Mobilization of Health Resources for Defense. Dr. Norvin C. Kiefer, Director, Health Resources Office, National Security Resources Board.
The Duties of Physicians in an Atomic Disaster. Brig. Gen. James P. Cooney, M. C., USA, Chief, Radiological Branch, Military Application Division, Atomic Energy Commission.
Atomic Bomb Effects—Teaching Aids from Armed Forces Institute of Pathology. Dr. Elbert DeCoursey, Director, Armed Forces Institute of Pathology.
Discussion

LUNCHEON

Grand Ballroom—12:15 P.M.

$3.40 per plate

Afternoon Session

2:00 P.M.—4:30 P.M.

Chairman, Dr. John D. Camp, Chairman, Commission on Education
The Diagnosis and Treatment of Radiation Injuries. Comdr. Eugene Cronkite, USN, M. C., Naval Medical Research Institute.
Training for the Detection of Radiation Hazards—Instruments—Personnel. Dr. William Bale, Biophysics Branch Division of Biology and Medicine, Atomic Energy Commission.
Radioactive Decontamination. Dr. Claude R. Schwob, Chief of the Chemistry Branch, U. S. Naval Radiological Defense Laboratory.
Discussion

The Conference is being sponsored by the Commission on Education and the Commission on Radiological Units, Standards and Protection of the American College of Radiology. Reservation forms will be distributed with the December issue of the Monthly *News Letter* of the College, or may be obtained by writing the American College of Radiology, 20 North Wacker Drive, Chicago 6, Illinois.

MEDICAL COURSE IN RADIOISOTOPE WORK

A special two-weeks advanced medical course in radioisotope work will be given by the Oak Ridge Institute of Nuclear Studies beginning on February 5, 1951. The course, dealing with radioisotopes in therapy and in clinical studies, is intended for research workers in the field of medicine who have had some experience in the basic techniques of using radioisotopes.

Lecturers from numerous hospitals using radioisotopes, Oak Ridge National Laboratory, and staff members of the Medical and Special Training Divisions of the Institute will participate in the course. Laboratory

sessions will be conducted by staff members of the Special Training Division which is headed by Dr. Ralph T. Overman.

The first week will be devoted to lectures and laboratory work on radioisotopes in therapy. Subjects covered during this period will include clinical radioautography, phosphorus 32, radium implantation, colloidal gold and other isotopes, and iodine 131 along with the interaction of radiation with matter, radiation safety, radiation laboratory design, radiation administration in a hospital, dosimetry, and effects of radiation on blood.

The second week will be concerned with radioisotopes in clinical tracer studies. Subjects covered during this period will include the diagnostic techniques of brain tumor localization and thyroid metabolism studies, water balance studies, cardiovascular research and blood volume, iron metabolism studies, radiation genetics, steroid studies, phospholipid studies, advances in medical instrumentation, protein metabolism studies, other non-mineral metabolism studies, mineral metabolism studies in experimental animals and mineral metabolism studies in humans.

A limited number of applicants who are only able to attend for one week can be accommodated. A fee of $25 will be charged for the course.

Applications are available from Dr. Ralph T. Overman, Chairman of the Special Training Division, Oak Ridge Institute of Nuclear Studies, P.O. Box 117, Oak Ridge, Tennessee.

FELLOWSHIP IN PEDIATRIC ROENTGENOLOGY

Applications are being accepted for the Fellowship in Pediatric Roentgenology in the Children's Hospital of Cincinnati. The Fellowship is administered by the Department of Roentgenology of the University of Cincinnati for work and study in the Department of Roentgenology in the Children's Hospital. Two years prior training in Radiology in an approved institution is required. The Fellowship runs for a period of one year beginning July 1, 1951. For further particulars, communications should be addressed to Dr. Frederic N. Silverman, Director, Department of Roentgenology, Children's Hospital, Cincinnati 29, Ohio.

KENTUCKY RADIOLOGICAL SOCIETY

At the October, 1950, meeting of this Society, it was voted unanimously to change the name of the Society from the Louisville Radiological Society to the Kentucky Radiological Society. At the November meeting of the Kentucky Radiological Society the following officers were elected: *President*, Dr. John Dixon, Owensboro, Kentucky; *Vice-President*, Dr. E. Lee Shiflett, Louisville, Kentucky; *Secretary-Treasurer*, Dr. E. L. Pirkey, Louisville, Kentucky. The Society will continue to meet on the second Friday of each month at 6:30 P.M. in the Seelbach Hotel, Louisville.

NORTH CAROLINA RADIOLOGICAL SOCIETY

At a meeting of the North Carolina Radiological Society at Watts Hospital, Durham, North Carolina, on November 11, 1950, the following officers were elected for the year 1950–1951: *President*, Dr. J. T. Marr, Winston-Salem, N.C.; *President-Elect*, Dr. Allen Tuggle, Charlotte, N.C.; *Vice-President*, Dr. J. Donald McRae, Asheville, N. C.; *Secretary-Treasurer*, Dr. James E. Hemphill, Charlotte, N.C.

BOOK REVIEWS

Books sent for review are acknowledged under: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interest of our readers as space permits.

Clinical Therapeutic Radiology. By U. V. Portmann, M.D., Editor, Head of Department of Therapeutic Radiology, Cleveland Clinic Foundation; Professor of Therapeutic Radiology, Bunts Educational Institute, Cleveland. Cloth. Price, $15.00. Pp. 748, with numerous illustrations. Thomas Nelson & Sons, 385 Madison Avenue, New York, 17, New York, 1950.

It does not require a very long bookshelf to accommodate all the available books in English on the various phases of radiotherapy. Much of that literature is highly technical and prepared from the physical and biophysical standpoint. We therefore welcome this attractive text on clinical radiology which provides the essential information on the clinical phases of roentgen therapy and radium therapy as well as the medical uses of the radioactive isotopes.

After building a firm background of surgical and anatomo-pathologic training and practice, the editor of this volume dedicated himself to the specialty of therapeutic radiology, and in the service of a large clinic has acquired an enormous experience, the benefit of which is now extended to all interested in radiology. The seven hundred page book before us by the editor and more than fifty collaborators is eloquent testimony of the great advance made in this field, to which the editor himself has contributed in a notable manner. On opening the book at almost any page one is impressed that the consideration of the subject has been thorough and the subject matter concisely stated. Careful study of some of the individual sections fully confirms this impression. The book should be in the hands of every medical practitioner, teacher and student of radiology for daily guidance.

James T. Case, M.D.

Collectio Radiographica Cranii et Cerebri I. Craniopharyngioma. (In Lingua Anglica, Gallica, Germanica, Hungarica.) By Ludovicus Haas, Docens Universitatis Scientiarum Budapestinensis, Primarius Roentgenologiae Nosocomii Municipalis "Koranyi." Paper. Pp. 39, with 23 illustrations. Magyar Orvosok Szabad Szakszervezete, Kiadóhivatala, Budapest, Hungary, 1948.

This is the first small but excellent monograph of a projected series of small books which are to comprise a collection on the roentgen diagnosis of the skull and brain. This first little "diagnostic picture book" is an excellent introduction to the series and concerns craniopharyngioma and its diagnosis. The origin, development and pathologic characteristics, as well as clinical symptoms, prognosis and roentgen interpretation of this lesion are summarized by the author. Dr. Lewis Haas has for nearly three decades been the foremost roentgenologist in Hungary and has interested himself in the problems of roentgen diagnosis of the skull and brain tumors over most of this time. The amateur linguist will be delighted with the polyglot text—the Preface and the Text are printed in English, French, German and Magyar and all legends beneath the illustrations are in the four languages. The title page is in Latin.

William M. Loehr, M.D.

Cytologic Diagnosis of Lung Cancer. By Seymour M. Farber, M.D., Milton Rosenthal, M.D., Edwin F. Alston, M.D., Mortimer A. Benioff, M.D., and Allen K. McGrath, Jr., M.D. From the University of California Medical Service and the Department of Pathology, San Francisco Hospital and the San Francisco Department of Public Health. Cloth. Price, $6.00. Pp. 59, with 60 illustrations on 10 plates. Charles C Thomas, Publisher, 301 East Lawrence Avenue, Springfield, Illinois, 1950.

The chief merit of this book, which is based on the study of 1,526 cases, lies in its description of the criteria for malignant cells. At the same time the special hazards in the evaluation of cells from the respiratory tract are pointed out. The discussion of the cellular elements seen in non-neoplastic diseases includes the range of variability of these cells and possibilities of confusion with neoplastic cells. The sections

devoted to the preparation of sputum or bronchial secretions contain useful suggestions, especially in regard to the transportation of fixed material by mail. Staining techniques are described briefly but with adequate references. The chapter dealing with the reasons for the author's preference for the smear as opposed to the blocked and sectioned preparations will provide much material for discussion by proponents of both techniques. Fundamental background material is dealt with succinctly but prepares the informed reader for the material that follows. The conclusion that a positive cytological diagnosis merits as serious consideration by the surgeon as does a positive tissue diagnosis will not meet with general agreement. However, the statistical analysis of the cases reported show that a high degree of reliability is possible. Adequately illustrated and covering a wide range of cellular changes in both neoplastic and non-neoplastic conditions, this book will be especially useful to the cytologist who wishes to improve his results in the diagnosis of cancer of the lung. In the closing paragraph the need of extensive experience with the method is emphasized, and the utmost caution with positive diagnoses is urged until they can be justified by such experience.

Daniel F. Glaser, M.D.

Bone and Joint Diseases. Pathology Correlated with Roentgenological and Clinical Features. By J. Vernon Luck, M.S. (Ortho.), M.D., F.A.C.S., F.I.C.S., Assistant Clinical Professor of Orthopedic Surgery, University of Southern California, Senior Attending Physician, Department of Orthopedic Surgery, and Consultant in Orthopedic Pathology, Los Angeles County Hospital, Member, Subcommittee in Orthopedic Surgery, National Research Council, Member, Board of Associate Editors, *Journal of Bone and Joint Surgery*. Cloth. Price, $16.50. Pp. 614, with 703 illustrations. Charles C Thomas, Publisher, 301 East Lawrence Avenue, Springfield, Illinois, 1950.

The author spent ten years in the preparation of this book on bone and joint diseases. He felt the urgent need for further correlation of pathological anatomy of bone and joint diseases with the clinical and roentgenologic aspects. In the preface, he states that he had this need constantly in mind while writing the text. His desire was to bridge the chasm that has existed between the laboratory and the clinical practice of medicine, placing emphasis upon the "dynamic quality of pathologic events" and upon the fact that "disease is not a thing but a process." Necessarily, he had to adopt a textbook style of presentation and although it might be didactic, it was not to be dogmatic and certainly not judicial. There was to be no obligation to supply a theory to explain each of the numerous unanswered questions in the field of bone and joint pathology.

Study of the book indicates that he obtained definite success in the correlation of pathological, roentgenological and clinical findings. Especially is this true of the pathological and clinical sections under each disease. Roentgenologists may feel the lack of complete roentgenographic descriptions in correlation with the pathological findings which in some instances are not of a very detailed character as in others. In the great majority of cases they are sufficient, however. There is certainly no attempt to set forth dogmatically certain theories, but, on the other hand, conservative estimates of various sides of controversial questions are found.

The book is attractively and well bound and the style is very readable and pleasing. It is arranged in twenty-two chapters. All diseases of practical interest are included and only a few extremely rare conditions have been omitted. The illustrations are satisfactory and the pathological sections in full color illustrate admirably the pathological descriptions. The bibliography is ample.

While the book is not a complete atlas of roentgenographic examples showing the progress of each disease, it fulfills well the author's purpose in producing it. The book contains much useful information and is extremely well worth inclusion in the library of the roentgenologist. It will be of great assistance to him in his study and interpretation of orthopedic conditions.

R. S. Bromer, M.D.

Die Pathologie des Harnleiters im Röntgenbild. Von Privatdozent Dr. Anton Thelen. Paper. Pp. 87, with 71 illustrations. Georg Thieme, Diemershaldenstrasse, 47, Stuttgart, Germany, 1949.

Although the author found many isolated case reports of dilatation of the ureter demon-

strated roentgenologically the subject has never been studied systematically. This induced him to undertake a clinical and roentgenological investigation of the behavior of the ureter under normal and abnormal conditions. The results of his work are related in this monograph supported by 57 case histories and 70 well reproduced and instructive roentgenograms.

Following a brief introduction outlining the problem, the anatomy, physiology, pathologic physiology, and the visualization of the ureter in the roentgenogram are discussed. Thelen grouped his roentgen findings under four main headings: congenital anomalies; obstruction of the ureter (due to pathologic processes in the urethra, bladder or ureter proper); inflammatory processes (including cystitis, pyelitis and tuberculosis of the kidneys); and dynamic-functional disturbances (nephroptosis, hydronephrosis, ureterolithiasis). From the author's observations it appears that nearly all pathologic processes occurring in the genitourinary organs are apt to produce in the ureters changes which are demonstrable in the roentgenogram. Deviations from the normal are predominantly in tonus and motility; most of the underlying causes lead to loss of tonus and consequently to dilatation. The bibliography is limited largely to the German literature. The monograph is recommended to all those interested in urologic roentgen diagnosis.

Ernst A. Pohle, M.D.

L'Organisation des Os. Par Pierre Lacroix, Professeur à la Faculté de Médecine de Louvain. Paper. Price, 900 Fr. Pp. 230, with 87 illustrations. Éditions Desoer, Liège. Masson et Cie, 120, boulevard Saint-Germain, Paris 6e, France, 1949.

The book gives the results of experiments concerning the development of bone tissue. The experimental procedures consisted of transplantation of different components of embryonic and adult bone tissue and cartilage into the subcapsular space of kidneys of young rabbits. In some cases, brain or the medullary cavity of the heart were used. Numerous drawings from histological slides illustrate the results obtained.

The book contains a very complete bibliography. The work is of special interest to histologists and embryologists.

Karol Matzinger, M.D.

Atomic Physics. By Wolfgang Finkelnburg, Ph.D., Formerly Professor of Physics, University of Strassburg. Translated from the Revised German Edition in Cooperation with the Author by George E. Brown, M.Sc. First edition. Cloth. Price, $6.50. Pp. 498, with 226 illustrations. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 18, New York, 1950.

This book is a translation from the revised German edition of "Einführung in die Atomphysik" published originally in 1948 by Springer. Due to this history the literature references are unusually complete and comprise a long list of European books and articles published during the second World War. The text is based upon a wide teaching experience of the author who was formerly professor of physics in Strassburg. The organization of the material presented in the book differs somewhat from the more or less standardized scheme of other publications on the subject in that it lays stress on the importance of experiment and theory in the interrelation between atomic, molecular, nuclear and solid-state physics. Therefore, fundamental concepts and the interrelations between the different subjects are emphasized and experimental details as well as practical applications of various measures are only mentioned to the extent which makes a thorough understanding of these relationships possible. Thus the author starts on a rather elementary level in discussing atoms, ions, electrons, atomic nuclei and photons but, building upon a rather solid framework of theory, he leads the reader through discussions of atomic spectra, atomic structure, atomic theories according to quantum mechanics, nuclear physics, molecular physics to the atomic physics of the liquid and solid state. Theoretical relationships between the different fields are lucidly presented and experimental apparatus and measures are well described and splendidly illustrated in over two hundred figures. The presentation culminates in present trends of research and also throws light on unsolved problems in this field. The important role which atomic physics plays not only in physics but in many other fields of science such as chemistry, astrophysics, mineralogy as well as in technology, industry, engineering is emphasized and philosophical consequences of the use of atomic physics are developed.

This complete treatment of the wide field of

atomic physics can be highly recommended to everyone interested in the subject. The medical radiologist might be reluctant to study the text feeling that it goes a little bit too deep into the theoretical aspect of atomic physics.

Otto Glasser, PhD.

Ionization Chambers and Counters. Experimental Techniques. By Bruno B. Rossi, Professor of Physics, Massachusetts Institute of Technology; and Hans H. Staub, Professor of Physics, Stanford University. First edition. Cloth. Price, $2.25. Pp. 243, with numerous illustrations and tables. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 18, New York, 1949.

This volume of the National Nuclear Energy Series is a contribution from the Los Alamos Laboratory.

It is divided into nine chapters: the first four are devoted to the fundamental aspects of ionization in gases and to the basic properties of detectors based upon the ionization process; the rest of the book is concerned with design of apparatus intended for the detection of photons, neutrons, the elementary ionizing particles and fission fragments. A brief appendix includes graphs of range, energy relationship and stopping power of alpha particles, deuterons, protons, and miscellaneous data useful in nuclear physics techniques.

The authors have succeeded in compiling a book of great usefulness to the graduate student and the experimental nuclear physicist by adding to the experimental contributions of their Laboratory many concise but clear expositions of inelastic collision processes in gases.

The radiological physicist will commit no mistake in adding this valuable and inexpensive book to his library.

L. D. Marinelli

The Characteristics of Electrical Discharges in Magnetic Fields. National Nuclear Energy Series. Manhattan Project Technical Section. Division I—Volume 5. Edited by A. Guthrie, Ph.D., Radiation Laboratory, Department of Physics, University of California; and R. K. Wakerling, Ph.D., Radiation Laboratory, Department of Physics, University of California. First edition. Cloth. Price, $3.50. Pp. 376, with numerous graphs and tables. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 18, New York, 1949.

This volume is a contribution of the Radiation Laboratory of the University of California under contract with the Manhattan District during World War II. According to the Editors "This volume should be considered primarily as a compilation of observations made in the course of developing high-vacuum equipment suitable for use in the electromagnetic separation plants." Your reviewer considers their claim somewhat too modest, since a remarkable degree of cohesiveness has been achieved in the presentation.

The book consists of five chapters: Chapter 1, by R. Loevinger, deals with the basic theory of vacuum practice; Chapter 2, by W. E. Bush, describes the elements of a vacuum system and their performance; K. M. Simpson devotes Chapter 3 to vacuum gauges and their characteristics; Chapter 4, by W. E. Bush, covers vacuum materials and equipment; R. Loevinger and A. Gutrie discuss at length leak detection in Chapter 5.

Although a student may find objections to its didactic approach, the designer of vacuum equipment will find this volume a source of much information.

L. D. Marinelli

BOOKS RECEIVED

Clinical Therapeutic Radiology. By U. V. Portmann, M.D., Editor, Head of Department of Therapeutic Radiology, Cleveland Clinic Foundation; Professor of Therapeutic Radiology, Bunts Educational Institute, Cleveland, Cloth. Price, $15.00. Pp. 748, with numerous illustrations. Thomas Nelson & Sons, 385 Madison Avenue, New York 17, New York, 1950.

Lehrbuch der röntgenologischen Differentialdiagnostik. Band I. Erkrankungen der Brustorgane. Von Werner Teschendorf, Köln. Zweite Auflage. Cloth. Price, DM 84.–. Pp. 779, with 865 illustrations. Georg Thieme, Diemershaldenstrasse, 47, Stuttgart, Germany, 1950.

Lehrbuch der röntgenologischen Differentialdiagnostik. Band II. Erkrankungen der Bauchorgane. Von Werner Teschendorf, Köln. Zweite Auflage. Cloth. Price, DM 72.–. Pp. 608, with 1,081 illustrations. Georg Thieme, Diemershaldenstrasse, 47, Stuttgart, Germany, 1950.

Radiographic Atlas of Skeletal Development of the Hand and Wrist. Based on the Brush Foundation Study of Human Growth and Development initiated by T. Wingate Todd, M.D., Ch.B., F.R.C.S., Late Henry Willson Payne Professor of Anatomy in Western Reserve University School of Medicine. By William Walter Greulich, M.A., Ph.D., Professor of Anatomy, Stanford University School of Medicine, etc.; and S. Idell Pyle, M.S., Research Associate, Brush Foundation and Department of Anatomy, Western Reserve University School of Medicine. Cloth. Price $10.00. Pp. 190, with numerous illustrations. Stanford University Press, Stanford, California, 1950.

Retroposition of Lumbar Vertebrae. Acta chirurgica Scandinavica, Supplementum 143. By Lars Hagelstam. Paper. Pp. 152, with numerous tables and illustrations. Tilgmanns Tryckeri, Helsingfors, Finland, 1949.

The Digestive Tract in Roentgenology. By Jacob Buckstein, M.D., Assistant Professor of Clinical Medicine, Cornell University Medical College; Visiting Roentgenologist (Alimentary Tract Division), Bellevue Hospital, New York City; etc. Cloth. Price, $18.00. Pp. 889, with 1,030 illustrations in 659 figures. J. B. Lippincott Company, East Washington Square, Philadelphia, Pennsylvania, 1948.

Le zone polmonari. By Dott. Lucio di Guglielmo. Cardboard. Price, L. 2,800. Pp. 303, with 231 illustrations. Edizioni Scientifiche Italiane, Galleria Umberto I, 83, Napoli, Italy, 1950.

Intussusception in Children. Diagnosis and Therapy with Barium Enema. *Acta radiologica*, Supplementum LXV. By Hans Hellmer. Paper. Price, Swedish Crowns 15.–. Pp. 120, with 50 illustrations. Håkan Ohlssons Boktryckeri, Lund, Sweden, 1948.

Carotid Angiography, with Special Reference to the Diagnosis of Cerebral Gliomas. *Acta psychiatrica et neurologica*, Supplementum No. 55. By A. Torkildsen, Oslo. Paper. Pp. 168, with numerous illustrations. Ejnar Munksgaard, Copenhagen, Denmark, 1949.

Arteriosclerosis and Arterial Thrombosis in the Lower Limb. A Roentgenological Study. *Acta radiologica*, Supplementum LXXX. By Åke Lindbom. Paper. Pp. 80, with 42 illustrations. Esselte Aktiebolag, Stockholm, Sweden, 1950.

Klinische Pathologie der Blutkrankheiten. Von Prof. Dr. Rudolf Schoen, Direktor der Medizinischen Universitätsklinik zu Göttingen; und Prof. Dr. Walter Tischendorf, Oberarzt der Medizinischen Universistätsklinik zu Göttingen. Cloth. Price, DM 57.–. Pp. 521, with 101 illustrations. Georg Thieme, Diemershaldenstrasse, 47, Stuttgart, Germany, 1950.

Urological Surgery. By Austin Ingram Dodson, M.D., F.A.C.S., Richmond, Virginia, Professor of Urology, Medical College of Virginia; Urologist to the Hospital Division, Medical College of Virginia; Urologist to Crippled Children's Hospital; Urologist to St. Elizabeth's Hospital; Urologist to St. Luke's Hospital and McGuire Clinic. Second edition. Cloth. Price, $13.50. Pp. 885, with 645 illustrations. C. V. Mosby Company, 3207 Washington Boulevard, St. Louis 3, Missouri, 1950.

Surgical Treatment for Abnormalities of the Heart and Great Vessels. The Beaumont Lecture. Wayne County Medical Society, Detroit, Michigan. Second printing. By Robert E. Gross, M.D., William E. Ladd Professor of Child Surgery, Harvard University Medical School, Boston, Massachusetts. Fabrikoid. Price, $2.00. Pp. 72, with 36 illustrations. Charles C Thomas, Publisher, 301 East Lawrence Avenue, Springfield, Illinois, 1950.

Malignant Disease and Its Treatment by Radium. By Sir Stanford Cade, K.B.E., C.B., F.R.C.S., M.R.C.P., Surgeon, Westminster Hospital; Consulting Surgeon, Mount Vernon Hospital and Radium Institute; Lecturer in Surgery, Westminster Medical School and formerly Examiner in Surgery, University of London; etc. With a Foreword by Sir Ernest Rock Carling, F.R.C.P., F.R.C.S., F.F.R., Consulting Surgeon and Vice-President, Westminster Hospital. Volume III. Second edition. Cloth. Price, $12.50. Pp. 446, with 548 illustrations. The Williams & Wilkins Company, Mount Royal and Guilford Avenues, Baltimore, Maryland, 1950.

Primary Carcinoma of the Vagina. By Robert G. Livingstone, M.D., formerly, Member Resident Staff, Gynecological Division, Memorial Hospital for the Treatment of

Cancer and Allied Diseases, New York City. Fabrikoid. Price, $2.00. Pp. 72, with several illustrations. Charles C Thomas, Publisher, 301 East Lawrence Avenue, Springfield, Illinois, 1950.

Cancer. A Manual for Practitioners. Second edition. Cloth. Price, $2.00. Pp. 308. Published by the American Cancer Society (Massachusetts Division), Inc., 462 Boylston Street, Boston 16, Massachusetts, 1950.

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Atomic Physics. By Wolfgang Finkelnburg, Ph.D., Formerly Professor of Physics, University of Strassburg. Translated from the Revised German Edition in Cooperation with the Author by George E. Brown, M.Sc. First edition. Cloth. Price, $6.50. Pp. 498, with 226 illustrations. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 18, New York, 1950.

Religious Welfare Committee of the New York Committee on Atomic Information, Inc. Eighth Exploratory Meeting. Biological, Medical and Health Effects and Implications of Atomic Energy in New York City. Held at the Academy of Medicine, 2 East 103rd Street, New York City, April 26th, 1949, 3:00 p.m. Paper. Price, $1.00. Pp. 40. New York Committee on Atomic Information, Inc., 39 Broadway (Room 1901), New York, 6, New York, 1949.

Handbook of Physical Medicine and Rehabilitation. Selections authorized for publication by The Council on Physical Medicine and Rehabilitation, American Medical Association. Published for the American Medical Association. Cloth. Price, $4.25. Pp. 573, with 56 illustrations and 25 tables. The Blakiston Company, 1012 Walnut Street, Philadelphia 5, Pennsylvania, 1950.

Infrared Radiation Therapy Sources and Their Analysis with Scanner. By Leopold Rovner, Consulting Physicist, Cambridge, Massachusetts. Fabrikoid. Price, $1.50. Pp. 34, with 21 illustrations. Charles C Thomas, Publisher, 301 East Lawrence Avenue, Springfield, Illinois, 1950.

Light Therapy. By Richard Kovacs. M.D., Professor of Physical Medicine, New York Polyclinic Medical School and Hospital. Fabrikoid. Price, $2.25. Pp. 112, with 28 illustrations. Charles C Thomas, Publisher, 301 East Lawrence Avenue, Springfield, Illinois, 1950.

Proceedings of the First Clinical ACTH Conference. Edited by John R. Mote, M.D., Medical Director, Armour Laboratories. Cloth. Price, $5.50. Pp. 624, with 414 illustrations. The Blakiston Company, 1012 Walnut Street, Philadelphia 5, Pennsylvania, 1950.

Annual Report of Professional Services, 1949. Paper. Pp. 118, with numerous charts and tables. Veterans Administration Hospital, 130 West Kingsbridge Road, Bronx 63, New York.

ABSTRACTS OF RADIOLOGICAL LITERATURE

Department Editor: T. Leucutia, M.D., Harper Hospital, Detroit 1, Michigan

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ROENTGEN DIAGNOSIS

HEAD

Edwards, Colin. Hyperostosis frontalis interna and calvariae diffusa with surgical relief of severe headache (also bilateral scalenus anticus syndromes). *Proc. Roy. Soc. Med.*, April, 1950, *43*, 251–252.

The case history of a forty-eight year old female is presented.

The past history to the age of thirty-eight included: menarche at the age of eight; phlebitis in both legs at thirty-one; cellulitis and osteomyelitis in the tibia of one leg at thirty-six accompanied by eight months' amenorrhea; headaches since childhood; patient was always obese.

Laboratory and neurological findings were negative. Roentgenograms of the skull showed hyperostosis frontalis interna, calvariae diffusa, calcification of falx and normal sella.

From thirty-eight to forty-three years the patient had a smoldering osteomyelitis of the tibia. During these years the headaches became increasingly severe and were accompanied by loss of vision for about twenty minutes with flashes of light as vision returned. Occasionally vomiting accompanied headaches. The patient's visual acuity diminished rapidly and the fields became markedly contracted. The optic foramina were roentgenologically normal.

At forty-three a right subtemporal decompression showed abnormally thick, hard, brittle and vascular temporal bone with an irregular inner surface to which the vascular dura was attached at many points. Headaches were less severe for one year and then became progressively worse.

At forty-seven years a left frontal decompression was performed. The bone flap was thick with no evidence of diploe. The under surface was craggy and the dura was adherent at many points. Relief from headache was marked.

At forty-six years a right scalenus anticus syndrome developed and was relieved by operation. Some features of a left scalenus anticus syndrome are now present at forty-eight years. —*D. R. Bernhardt, M.D.*

Baker, G. S., Dockerty, M. B., and Kennedy, R. L. J. Fibromyxosarcoma of the skull and meninges: report of case. *Proc. Staff Meet., Mayo Clin.*, March 15, 1950, *25*, 129–134.

This is a case report of a rare type of tumor involving the skull and meninges. It is the first case seen at the Mayo Clinic. The definite diagnosis was made at time of operation.—*J. H. Harris, M.D.*

de Sousa Pereira, A. Influence of the autonomic nervous system on the cerebral blood supply. *Arch. Surg.*, March, 1950, *60*, 456–464.

The author reports 6 cases with neurologic disturbances due to disorders of the arterial circulation of the brain. A study of the cerebral circulation was done by injecting 12 cc. of thorotrast into the primitive carotid artery. Then roentgenograms of the three phases (arterial, arteriovenous and venous) of the brain circulation were obtained. After arteriographic study, the author carried out repeated blockings of the middle cervical and stellate ganglions by means of descending infiltration anesthesia. In cases in which a favorable result concerning neurologic symptoms was obtained, the surgical interruption of the cerebral vasomotor

innervation was performed. Then bilateral cervical sympathectomy was done, completed by periarterial sympathectomy of the carotid and vertebral arteries.

Postoperative arteriographic studies were then carried out at times varying from ten days to five months after the operation. These were compared with preoperative arteriograms.

The first 3 patients suffered from hemiplegia on the right side and aphasia. Arteriograms revealed complete thrombosis of the left internal carotid in the patient and the other 2 patients had partial thrombosis of this artery.

The fourth patient developed hemiplegia on the left side after injury to the head. Arteriogram demonstrated a partial thrombosis of right internal carotid artery.

The fifth patient presented progressive hemiparesis and hemiatrophy of upper and lower limbs on the left side. The arteriogram revealed arterial ischemia of the frontal lobe and anterior part of the parietal lobe on the right side.

The sixth patient developed hemiplegia on the left side following a bullet wound to the right side of the brain. Arteriograms of right internal carotid one and one-half months later revealed a pronounced diminution of the caliber of the cerebral arterial branches located near the wound in the brain.

The author concluded that all these patients had definite clinical improvement and that the blood supply to the involved portion of the brain was definitely increased when he compared preoperative arteriograms with postoperative arteriograms.—*C. P. Truog, M.D.*

BARTH, EARL E., and IRWIN, GEORGE E., JR. Traumatic pneumocephalus. *Radiology*, March, 1950, *54*, 424–427.

The immediate development of pneumocephalus following skull fracture is reported. Pneumocephalus most frequently follows injuries to skull with fractures extending into the inner wall of the paranasal sinuses or the mastoid cells. It is occasionally found in association with inflammatory processes and tumors which invade the inner walls of these structures. The air collections may be (1) intracerebral, (2) subdural, (3) subarachnoid, or (4) intraventricular. An explanation for the various locations of air is given. Mortality of pneumocephalus formerly approximated 50 per cent, but with use of recent drugs the superimposed infections and resulting mortality should be reduced. Conservative treatment is indicated.—*E. E. Seedorf, M.D.*

STAFNE, EDWARD C. Dental roentgenologic aspects of systemic disease. *J. Am. Dent. A.*, March, 1950, *40*, 265–283.

This is an excellent survey and review of manifestations of systemic diseases as seen in dental roentgen examination. By way of introduction, the author mentions that in a series of cases which he and his co-author, Austin, studied, 17 per cent of cases of Paget's disease revealed evidence of the condition in dental films. The author of this paper, as well as others, has found evidence of hyperparathyroidism detected by examination in the dental department. Endocrine disturbances may cause malocclusion and this condition can also be caused by dietary deficiencies, congenital syphilis, and tuberculosis. Constitutional factors may cause delay in time of eruption of the teeth.

The author discusses in considerable detail the influence upon dental studies of the ductless glands—pituitary, thyroid, parathyroids, gonads, pancreas—and vitamin deficiencies, particularly vitamin D. Consideration is also given to developmental disturbances of the skeleton, such as Albers-Schönberg disease, achondroplasia, cleidocranial dysostosis, Hand-Schüller-Christian's disease, multiple myeloma, Paget's disease, ectodermal dysplasia, and acrosclerosis.

Other conditions, mentioned but not described, identifiable on roentgen examination of the teeth and jaws, include osteoporosis and necrosis caused by heavy metals such as arsenic, lead and radium; roentgenographic evidence of lesions of bone produced by syphilis, tuberculosis; and conditions of obscure etiology such as polyostotic fibrous dysplasia. He makes a plea for dentists engaged in hospital service to think in terms of diagnosis, both general and dental, and to cooperate with the general roentgenologist. "Knowledge of the dental and osseous manifestations of systemic disease opens a field in dental roentgenology that is a broad and difficult one, and yet it is one in which addition of knowledge and further development are largely the responsibility of the dentist."—*A. K. Wilson, M.D.*

KILBORN, LESLIE G., OUTERBRIDGE, T. S., and LEI, H. P. Fluorosis with report of an advanced case. *Canad. M. A. J.*, Feb., 1950, *62*, 135–141.

The use of sodium fluoride by the dental profession for the prevention of dental caries may not be without danger. Mottling of tooth

enamel results when fluorine in drinking water exceeds one or two parts per million when taken before the eruption of the permanent teeth. One part of fluorine per million in drinking water tends to decrease dental caries but more than this may result in fluorine poisoning or fluorosis. Fluorosis in factory workers has been reported from various countries, but its spontaneous appearance from the ingestion of an excess of fluorine in drinking water has not yet been reported from many localities.

The authors report studies of a skeleton obtained from an endemic center of fluorosis in China where stream water contained as high as 13.1 parts per million of fluorine. Natives from this area reported the onset of joint stiffness at about the age of ten years. These people became hunchbacks and cripples and died at an early age.

Chronic fluorosis in factory workers has resulted in early "arthritis," ankylosis of the spine with calcification of the spinal ligaments, and a diffuse osteosclerosis. The bones of the skeleton examined were found to be markedly strickened, porous and brittle. All bones were involved. The surfaces were roughened; anatomical prominences, ridges and sites of muscle attachment exaggerated. The spine was completely fused into one solid bone. The cortex of all bones was thickened with narrowing or obliteration of the medullary canal. Practically every bone showed a striking increase in weight. The enamel of the teeth was denuded or thin and pitted. An analysis of the fluorine content of the bones revealed nearly twenty times the normal. Roentgenograms of the bones showed increased density, thickening of the cortex and diminished medullary canals and absent or diminished trabeculation, findings resembling marble bone.

Endemic areas of fluorosis have been reported in India, Africa and South America. Sporadic cases have been observed in the United States and Canada. Awareness of chronic fluorine poisoning from dental caries prophylaxis and of sporadic cases of spontaneous fluorosis in the United States and Canada may clarify certain diagnoses of ankylosing spondylitis.—*W. L. Kilby, M.D.*

NECK AND CHEST

Howard, J. M., Rawson, A. J., Koop, C. E., Horn, R. C., and Royster, H. P. Parotid tumors in children. *Surg., Gynec. & Obst.*, March, 1950, *90*, 307–319.

The authors report on a group of patients in whom tumorous enlargement of the parotid gland first developed in childhood. Only tumors initially noted in patients younger than sixteen years of age are included.

Inflammatory Lesions. Chronic recurring infection of the parotid gland and its duct may produce a fibrotic nodular gland which can simulate a tumor. Characteristically, this type of inflammatory lesion has its onset in childhood. It is important to recognize the condition and to obtain a biopsy if necessary to make the diagnosis. Not infrequently, the condition is bilateral. These cases have been operated upon with a mistaken diagnosis of tumor and a postoperative facial paralysis has resulted in some instances.

Neoplasms of Connective Tissue Originally Arising Only Incidentally in the Parotid Gland.

1. Vascular tumors—Hemangioma and hemangioendothelioma. These are the characteristic tumors of the parotid in the first year of life. The hemangioendothelioma of infancy usually runs a benign course and does not have the ominous implications of the tumor of the same name in adults.

2. Lipoma—A lipoma located within the parotid gland is an uncommon finding.

3. Sarcoma—This occurs rarely in the salivary glands.

Neoplasms of the Salivary Gland Per Se.

1. Mixed tumor. The authors believe that the mixed tumor should be considered a nonmetastasizing neoplasm. Rarely, local invasion is seen. The local recurrences often noted following excision of these tumors are possibly explained by the multicentric origin of the lesion. Although the mixed tumor characteristically begins in young adulthood, it also occurs in childhood. The authors suggest that the so-called mixed tumors associated with carcinoma or sarcoma are really well differentiated carcinomas or carcinomas arising in mixed tumors. They believe that such lesions should be regarded as carcinomas rather than as mixed tumors because the prognosis is that of the carcinoma.

2. Papillary cystadenoma lymphomatosum. This tumor is also known as adenolymphoma or Warthin's tumor. It is an encapsulated and usually a small tumor which contains many small cysts. It seldom appears in childhood, being seen most commonly in old men. Most authorities believe that it is always a benign lesion.

3. Carcinoma. *A. Cylindroma.* This tumor, while malignant, runs a slow course, often

twenty years or more. It is locally invasive and metastasizes frequently but late to the regional lynph nodes and lungs. Response to irradiation has been noted. *B. Mucoepidermoid tumors.* This group is characterized by the simultaneous occurrence of mucin secretion and epidermoid features in a malignant epithelial neoplasm.

Miscellaneous (including parotid cyst).

1. Parotid cyst. The parotid cyst of the simple retention type has been referred to as a congenital cyst. However, only 1 of 24 reported cases was noted before the age of fifteen years.

2. Miscellaneous tumors. The authors have seen 2 neuroblastomas of the cervical sympathetic chain invading the lower pole of the parotid. An accessory lobe of the parotid gland was mistaken for a parotid tumor in one child.

Summary. The authors' 21 cases of nodular enlargements of the parotid gland, 15 of them primary salivary gland neoplasms occurring in infancy and childhood, are reported. The literature since 1920 is reviewed.—*Mary Frances Vastine, M.D.*

BROWN, J. B., MCDOWELL, F. and FREYER, M. P. Direct operative removal of benign mixed tumors of anlage origin in the parotid region; with summary of parotid tumors in general. *Surg., Gynec. & Obst.*, March, 1950, *90*, 257–268.

Incidence. The distribution of these mixed tumors in the salivary glands has been estimated as: parotid—89 per cent, submaxillary—10 per cent, and sublingual—1 per cent. In the authors' group the youngest patient was eleven years of age and the oldest seventy-eight years. Fifty-three per cent were in the thirty to fifty year age group with the greatest number being about forty years of age. Fifty-seven per cent of the patients were females and 43 per cent were males.

Diagnosis. The characteristic history is the appearance of a painless mass usually in the parotid region. The mass is of constant or slightly increasing size and not related to salivary stimulation.

Twenty-three per cent of the tumors in this group were malignant. The diagnosis of malignancy in the tumor can be made if there is fixation of the mass, paralysis of the seventh nerve, evidence of extension or metastasis or if there is rapid increase in the size of the tumor.

Pathological Summary. One hundred and forty-nine tumors of primary origin in the parotid region were operated upon. Of these, 67 per cent were benign mixed tumors; 3.4 per cent were benign papillary cystadenoma lymphomatosum; the remainder were angioma, 1.4 per cent, lymphangioma hygroma, 5.3 per cent and lipoma, 0.6 per cent.

Of the 23 per cent (149 tumors) which were malignant, 8.7 per cent showed the predominant picture to be that of mixed tumor; 9.3 per cent of these tumors was predominantly adenocarcinoma and 4.6 per cent, squamous cell carcinoma.

Treatment. A direct operative approach to benign mixed tumors of anlage origin in the parotid gland is advised. The chief advantages of the operation described by the authors are the wide uncovering of the parotid area by elevation of a large facial flap and the direct removal of the tumor by extremely careful dissection without damage to the seventh nerve. This plan is practical because of the anatomical arrangement of the nerve and gland inasmuch as most of the tumors occur superficially to the nerve. There has been no recurrence of the tumor nor has there been any injury to the facial nerve in any of the authors' cases.—*Mary Frances Vastine, M.D.*

MOREAU, MARCELO H., and MOREAU, JORGE E. Contribución a la exploración radiológica del cávum. (Contribution to the roentgen examination of the nasopharynx.) *Semana méd.*, March 9, 1950, *57*, 359–362.

The "cavum" is the nasal part of the pharynx. Its boundaries are the body of the sphenoid and the basilar apophysis of the occiput superiorly, the atlas and axis posteriorly, the soft palate, when raised, inferiorly and the two nasal choanae anteriorly. It is approximately cubical in shape measuring 4 cm. vertically, 4 cm. transversally and 2 cm. in the anteroposterior diameter. The superior wall constitutes the vault of the pharynx and contains considerable lymphoid tissue, the larger conglomeration also being called pharyngeal or Luschka's tonsil. On each lateral wall are the inner ostium of the eustachian tube and a little farther backward the fossa of Rosenmüller which in adults may occasionally be 1–2 cm. deep. The inferior wall exists only during deglutition, when the soft palate is raised toward the posterior wall of the pharynx.

The nasopharynx is seldom examined roentgenologically. The authors successfully used a

new technique which permits a better roentgen visualization of this region.

The patient is placed in straight dorsal-decubitus with the head fixed so that the vertical line passes from the border of the upper lip to the external auditory meatus. Rapidly, 4 cc. of a 50 per cent iodized oil is instilled into each nasal passage and roentgenograms are made in the anteroposterior and lateral views. For the anteroposterior view, the central ray is directed just underneath the chin, passing through the external auditory meatus. For the lateral view the tube is rotated horizontally, and the exposure is made with the patient's head in the same fixed position.

The lateral roentgenogram is the more informative of the two. It permits in particular the demonstration of lesions of the posterior and superior walls of the nasopharynx. The interpretation of the anteroposterior roentgenograms is rather difficult; the change in the amount of the instilled iodized oil and the variation of the interval between the instillation and the taking of the roentgenograms are notable confusing factors. For this reason, the authors at the present time prefer to make roentgenograms only in the lateral view, and to reserve the anteroposterior exposure for larger lesions.—*T. Leucutia, M.D.*

KEYNES, GEOFFREY. Thyroid survey fifty years ago, with a contribution on intrathoracic goitre. *Brit. M. J.*, March 18, 1950, *1*, 621–626.

This is the title of the second lecture in memory of Thomas Percy Legg, formerly surgeon to St. Bartholomew's Hospital. Two of his main interests were cleft palate and the surgery of the thyroid gland. There was a textbook famous in its time. Cheyne and Burghard's *Manual of Surgical Treatment*, first published in 1902. A new edition of this book was published in 1913. For it the authors called on the help of two younger surgeons, T. P. Legg and Arthur Edmunds. Much of Cheyne and Burghard's section on the thyroid, written fifty years ago, sounds surprisingly modern, for many of the fundamentals in any subject do not change. Kocher's transverse incision was recommended fifty years ago as the best for thyroid operations. The anesthesia was found to be the great difficulty and the chief danger to the patient's life. The skill and rapidity of the surgeons of those days in dealing with large goiters is implied in the light-hearted way in which the possibility of hemorrhage is mentioned, and in the statement that "about twelve ligatures" are all that need usually be applied.

Of exopthalmic goiter Keynes in 1902 observed, "This is essentially a medical affection, but attempts have been made of late to employ surgical treatment in these cases." The anesthetic and postoperative dangers were very great and the mortality extremely high. The use of iodine in exopthalmic goiter was still completely misunderstood, and it is coupled with thyroid extract as contraindicated. In 1902 ligation of arteries was regarded as of no value; its importance as a preliminary stage and as a life-saving operation was not appreciated.

Legg made little change in 1913 in the account of the operation for nontoxic goiter. There was one interesting addition—namely, a page of new matter dealing with intrathoracic goiter.

There are two main degrees of descent of the thyroid—retroclavicular and intrathoracic. Goiters may extend far down into the chest without causing pronounced symptoms. Frequently they reach the arch of the aorta or some distance below it. The main symptom is dyspnea, produced by displacement and compression of the trachea. Other symptoms include orthopnea, alteration of the voice and venous engorgement at the root of the neck and over the upper part of the chest. Chronic bronchitis is a common complication.

The operative treatment of intrathoracic goiter is often not very difficult. The surgeon must be prepared to open the mediastinum but almost always the tumor can be removed through the neck. Should the tumor be retroclavicular there will clearly be no great difficulty, as it can easily be dislocated upwards with the lobe of which it is a part. With an intrathoracic extension it may be difficult or impossible to introduce a finger beside the tumor and to reach its lower border, so that delivery of the tumor is prevented. Therefore, attention is for the time being directed entirely to that part of the tumor which is accessible in the neck. The isthmus is sometimes divided. After the whole of a lobe of the thyroid gland has been detached from its surroundings in the neck, the lobe is gently pulled upward and the thoracic portion follows, like a cork out of a

bottle. Sir James Berry used to employ a dinner-spoon to assist in thyroid delivery from awkward corners. There is always danger lurking in the acquirement of fixed habits of mind. A thoracic surgeon who assumes that all intrathoracic tumors can be suitably removed through a transpleural approach may find that a tumor supposed to be of thoracic origin has its main vascular connection some way up in the neck. In the same way, any general surgeon who aspires to be an exponent of the surgery of the endocrine triad—the thyroid, the parathyroid, and the thymus—must be prepared to extend his range into the mediastinum, or even the pleura and pericaridum.

Another problem is that of intrathoracic goiters which have enlarged in an unusual direction. A great majority of these descend into the anterior mediastinum immediately behind the sternum and inner ends of the ribs. Occasionally they enlarge downwards and backwards, reaching the posterior mediastinum on one or the other side behind the trachea and the upper lobe of the lung.

The author gives 4 case reports in which mediastinotomy was definitely necessary to accomplish removal of an intrathoracic thyroid. Two of these intrathoracic goiters were extremely large,—one weighing nearly 300 grams, the other 290 grams. A third was a very large aberrant intrathoracic goiter with severe thyrotoxicosis,—an association apparently never previously described.—*S. G. Henderson, M.D.*

HARE, HUGH, F. and NEWCOMB, RICHARD V. Carcinoma of the thyroid in children; a ten-year follow-up. *Radiology*, March, 1950, *54*, 401–407.

After a review of the literature on carcinoma of the thyroid in children the authors present a supplementary report to an original article published in 1937. The 5 patients reported have been followed from thirteen to eighteen years and aside from the long survival time have little in common. There was considerable variation in the histopathologic appearance of the tumors. An interesting observation was that pulmonary metastases of a similar nature appeared in 2 of the patients many years after the primary removal. There was 1 case of local recurrence.

The authors concluded: (1) that any mass observed in the thyroid of a child should be suspected of being malignant until proved otherwise; (2) that radiation therapy is indicated as an adjuvant to surgery in the treatment of thyroid cancer; (3) that distant metastases do not necessarily portend an unhappy outcome.—*E. M. Cooper, M.D.*

MERENDINO, K. A., and EMERSON, E. C. Aortoesophagogastric fistula, an unusual complication of esophagogastrostomy performed under the aortic arch following esophageal resection for carcinoma; a report of two cases. *J. Thoracic Surg.*, March, 1950, *19*, 405–411.

Two cases of aortoesophagogastric fistula are reported in detail. Both patients had esophagogastrostomy performed close to the under side of the aortic arch and developed sudden chest pain, dyspnea, shock, hematemesis, and died.

One fistula was secondary to a suture which had passed through the media of the aorta and the esophagogastric anastomosis in a patient with hilar and distant metastases. The other followed postoperative infection with benign ulceration at the side of anastomosis.

This complication may occur when the site of anastomosis is closely adjacent to the arch, particularly when there is trauma to the aorta or delayed healing. With immediate recognition of this condition the possibility of surgical repair is considered.—*Martha Mottram, M.D.*

GOLDMAN, A., and MASTERS, H. Leiomyoma of the esophagus. *Arch. Surg.*, March, 1950, *60*, 559–574.

This report reviews the literature and reports 2 cases in which leiomyoma of the esophagus was treated by successful operative intervention. Among 200 case reports of benign esophageal tumors in the literature, the following tissue types were encountered: adenoma, fibroma, hemangioma, lipomyoma, myoma, myxofibroma, neurofibroma, fibromyoma, papilloma, polyp, osteochondroma and leiomyoma. Since 1933, seven patients with leiomyoma have been treated by resection.

These tumors are usually in the distal third of the esophagus as extramucosal defects. Enucleation of the growth without entering the lumen is the desired procedure where possible. Occasionally esophageal resection is required for adequate removal.—*J. W. Turner, M.D.*

DOUGLAS, J. B., PETERSON, G. M., and BELL, J. C. The roentgen diagnosis of abnormalities

of the esophagus with special attention to some of the less common lesions. *South. M. J.* March, 1950, *43*, 223–229.

The authors comment on most of the common esophageal lesions and give a short discussion of some of the less common ones.

Of the congenital lesions, the tracheo-esophageal fistulae are the most significant and the importance of early diagnosis is stressed. Diaphragmatic hernia, diverticula of the esophagus and curling of the esophagus are next discussed briefly. Many hernias are associated with congenital abnormalities and herniation of a portion of the cardia through the esophageal hiatus is the most common type and is usually not associated with a congenitally short esophagus. One must be careful not to mistake the phrenic ampula for a hiatus hernia.

Achalasia or cardiospasm is considered to be the most frequent disturbance in function. The esophagus often becomes markedly dilated and contains large amounts of food. The extreme dilatation seen in this condition is contrasted with the usual lack of dilatation in carcinoma of the esophagus.

The authors state that 10 per cent of cases of acrosclerosis and scleroderma have dysphagia. Early fibrosis in the esophageal muscle results in impaired to absent peristalsis with delay in emptying, particularly of solid food. Dilatation may occur and is usually in the distal portion.

The most common inflammatory changes in the esophagus, when seen by the radiologist, are usually in the chronic stage. Stricture following ingestion of corrosive material is a common finding. Inflammatory changes following specific diseases such as scarlet fever, diphtheria, thrush, smallpox, measles or pemphigus may be seen. There are also nonspecific inflammations classified as follicular, exfolliative or leukoplakial esophagitis. Peptic esophagitis and peptic ulcer may also occur. The authors feel that esophageal ulcer is fairly rare and usually requires esophagoscopic confirmation.

Tuberculosis rarely involves the esophagus and then only in the presence of extensive pulmonary disease.

Abscesses and phlegmons are most frequently secondary to foreign bodies or perforations. The authors quote Culver and Clark in stating that esophageal perforations into the pleural space offer a poorer prognosis than perforation higher up in the mediastinum. They suggest that hydropneumothorax immediately following the sudden onset of chest or abdominal pain, accompanied by shock and collapse, is diagnostic of perforation of the upper gastrointestinal tract into the pleural space. They feel that the spontaneous pneumothorax is the most important consideration in differential diagnosis and in this condition alone there should be no fluid.

The problem of non-opaque foreign bodies is discussed and it is the opinion of the authors that roentgenographic studies should always precede esophagoscopy.

In their discussion of neoplasms they state that benign new growths are relatively rare and they point out that the esophagus can tolerate a fairly large slowly growing tumor with little or no evidence of dysphagia. Benign tumors may develop on very long pedicles and may occasionally be regurgitated. The most common site for carcinoma is in the distal half of the esophagus. The authors discuss the roentgen findings.—*J. G. Snead, M.D.*

Wolfsohn, H. Mediastinal abscess following removal of foreign body from oesophagus with subsequent pharyngo-oesophageal diverticulum. *Proc. Roy. Soc. Med.*, April, 1950, *43*, 316.

The case history of a thirty-seven year old female who was admitted to the hospital for mediastinitis and abscess three months after the esophagoscopic removal of a metal wire from the upper end of the esophagus is presented. Roentgenologic examination upon admission showed a rounded opacity in the right lower paratracheal zone. This soon spread to the upper right lung fields, then diminished in size and had practically disappeared in six weeks. A barium swallow examination made during the course of treatment demonstrated slight cardiospasm and a doubtful irregular indentation along the posterior pharyngeal wall opposite T3 to T5. Two months after admission to the hospital the patient was discharged to a convalescent home. Three weeks later the patient complained of an odd clicking sound when swallowing certain solids. There was a tendency to regurgitation of undigested food after swallowing. Barium swallow examinations made two months later, a total of seven months after the ingestion of the foreign body, revealed a pouch arising from the posterior hypopharyngeal wall at the level of C6 to T1.

It is believed that the trauma produced by

foreign body and the subsequent local inflammation damaged the weak "pharyngeal dimple" between the oblique and cricopharyngeal fibers of the inferior constrictor muscle. This produced herniation of the mucosa and submucosa, and, in consequence, a typical pulsion diverticulum.—*D. R. Bernhardt, M.D.*

PUPPEL, I. DARIN. The role of esophageal motility in the surgical treatment of mega-esophagus. *J. Thoracic Surg.*, March, 1950, *19*, 371–390.

Many surgeons have noted that even after adequate esophagogastrostomy the esophagus frequently does not return to its normal size although good functional results are obtained. This problem was studied by placing into the esophagus a balloon connected to a manometer. Motility studies were made on 3 normal persons and on 2 patients who had had surgery for achalasia of the esophagus. In the controls these studies revealed strong waves of peristalsis passing along the esophagus at a fairly rapid speed. These peristaltic waves occurred more frequently and were more effective when the patient attempted to swallow voluntarily. In patients with mega-esophagus the intrinsic motility varies greatly, being often irregular, uncoordinated, hyporesponsive to stimuli, and not completely effective. In fact, the intrinsic motility may be entirely absent or completely fail. This explains the inability of the esophagus to return to normal size following operation. It may also explain some of the failures of this operation.

These observations offer further evidence for the general theory of achalasia as an underlying mechanism of cause of idiopathic mega-esophagus.—*F. M. Reis, M.D.*

BONORINO UDAONDO, C., D'ALOTTO, V., and RESANO, H. Syndrome de Plummer-Vinson. (Plummer-Vinson syndrome.) *Arch. d. mal. de l'app. digestif.*, April, 1950, *39*, 478–483.

The authors describe 11 typical cases of Plummer-Vinson syndrome of their own. The syndrome usually occurs in women above forty but the authors have also seen it in 3 men, 2 aged seventy and 1 fifty-three. Dysphagia began suddenly in 4 cases. In the others the onset was gradual. Hypochromic anemia was present in most cases.

Dysphagia is usually the first symptom but occasionally anemia may precede dysphagia. Atrophy of the mucosae, glositis, cheilitis, clubbed fingers and fissures of the lips are often found. Loss of weight is almost the rule. Achlorhydria may be due to atrophic gastritis as was demonstrated in 1 of the authors' cases.

The roentgen findings are typical although often it is difficult to obtain good spot films of the pharyngo-esophageal region because of rapid transit. The patient is told to swallow all at once a thick barium mixture and to immediately stop breathing. Numerous spot films are then taken within a short time in the frontal and lateral views. The roentgenograms show a slight to moderate stenosis at the level of C_6 and C_7. This stenosis is smooth and often shows one or two indentations projecting within the lumen of the esophagus to a depth of 5 or 6 millimeters. The indentations usually arise from the anterior wall of the esophagus and are more frequently seen to the right. They are not to be confused with the normal incisure produced by the cricopharyngeal muscle on the posterior wall of the hypopharynx. These bands or webs may be clearly seen by esophagoscopy which was performed in 7 cases. Histopathological examination usually reveals hyperkeratinization with chronic inflammatory changes.

Contrary to the Scandinavian investigators, the authors do not believe that the Plummer-Vinson syndrome is a precancerous condition. Riboflavine is recommended for the cheilitis and fissures around the mouth. In the cases associated with sideropenia the administration of iron, together with dilatation of the hypopharynx, has produced spectacular results.—*J. P. Jean, M.D.*

RIGLER, LEO G. Roentgen examination of the chest. *J.A.M.A.*, March 18, 1950, *142*, 773–777.

In this excellent paper the author discusses the significance of a roentgenogram of the chest reported as normal in relation to various disease processes. The limitations of roentgen technique are surveyed in pulmonary edema, pneumonia, pulmonary tuberculosis, and metastases. The reference points for these observations are the appearance of abnormal findings on the roentgenogram with relation to the onset of symptoms and the size of the lesion permitting distinction from the normal pattern of the lung. Pulmonary edema is detectable six to twelve hours before the appearance of physical signs. The exception to this is when the edema is interstitial rather than alveolar. Then roentgen signs are slow to develop. This is also true for

atypical or virus pneumonias as nothing may be seen on the chest films for twenty-four to forty-eight hours after the onset of symptoms. Conversely, the bacterial pneumonias which cause rapid exudation of fluid into the alveoli are frequently detected within six hours of the onset of symptoms and almost invariably by twelve hours. With special techniques pleural effusions of as little as 100 cc. can be detected. Pulmonary tuberculosis is usually not demonstrable until eight to twenty weeks after exposure. Symptoms are rarely present. Acute miliary tuberculosis differs in that roentgen signs develop after symptoms have been present for a prolonged period. Metastases are visible on the roentgenogram before the onset of symptoms or physical signs. The nodular lesions produced by the metastases, however, must be 3 mm. or larger to be detectable. Bronchogenic carcinoma almost invariably gives positive roentgens signs when symptoms are present if a complete examination is done.—*T. D. Allison, M.D.*

Reed, Edsel S., Leikin, Sanford, and Kerman, Herbert D. Kerosene intoxication. *Am. J. Dis. Child.*, April, 1950, *79*, 623–632.

This paper consists of a study of a series of cases of kerosene ingestion presented with special reference to the clinical and roentgenological manifestations. Eighty-six per cent of the cases in which roentgen examinations were made showed definite pulmonary changes. The criteria for diagnosis of pulmonary abnormalities consisted in the finding of definite areas of increased density in the lung fields. Prominence of the bronchovascular markings was not considered as evidence of involvement unless associated with areas of parenchymal density. The roentgenologic appearance varied considerably in the individual patients. The findings ranged from a small patchy density in the right cardiophrenic angle in one child to large confluent mottled densities in another. These latter densities extended out from the hilar areas to involve the outer one-third of the pulmonary fields and were most pronounced in the right midpulmonary and lower pulmonary fields.

The pulmonary changes were most often seen bilaterally and were most pronounced in the base of the right lung. The changes were thought to be similar to those seen in pulmonary hyperemia or edema rather than pneumonitis. In 2 patients fluid was observed, in 1 there was bilateral pleural cavity involvement, in the other the left pleural cavity only was involved.

The changes observed developed rapidly after ingestion of kerosene and were usually resolved in approximately two weeks. Follow-up studies six months to four years after ingestion of kerosene revealed no definite evidence of residual pulmonary change. Analysis of the clinical and roentgenological data, as well as preliminary experimental studies, supports the evidence indicating that the pulmonary manifestations resulting from kerosene ingestion are due primarily to aspiration of the material into the pulmonary system. The use of oxygen in the early treatment of kerosene ingestion is emphasized by the authors.—*R. S. Bromer, M.D.*

Levine, R. M. Congential cystic disease of the lung. *Canad. M. A. J.*, Feb., 1950, *62*, 181–186.

Congenital cystic disease of the lung is still considered an uncommon, though not rare, condition, in spite of over 600 reported cases. Sex incidence is about equal. The disease manifests itself, according to age, in two distinct groups: (a) infants under one year; (b) adults over fifteen years.

Secondary infection, or progressive distention of the cysts with air is usually the first indication of the disease. The cavities may be filled with fluid or air or both. They may be solitary or multiple, and the latter may communicate with each other. All communicate with a bronchus though this may be difficult to demonstrate. The cysts are lined with pseudostratified ciliated columnar or cuboidal type of epithelium surrounded by a supporting tissue of muscle, cartilage or mucous gland tissue. The disease is usually unilateral. The acquired cyst is formed by rupture or overdistention of alveoli with the wall made of compressed pulmonary parenchyma and no epithelial lining.

Many theories of pathogenesis are offered but the majority believe congenital cysts arise from pinched-off buds of bronchial tissue.

Two cases, representative of the solitary and polycystic disease are recorded; the former occurred in an infant and the other in an adult. Both were successfully treated by pneumonectomy.—*W. L. Kilby, M.D.*

Stemmermann, Grant N., and Duffy, Robert W. Accidental cyst of the chest wall lined with bronchial epithelium. *J. Thoracic Surg.*, March, 1950, *19*, 349–354.

The authors report the case of a thirty-two year old male who nearly four years previously had been struck with fragments of an antiaircraft shell. Some of these had been removed shortly thereafter. He developed a pneumothorax and then an "acute pleurisy" and was hospitalized for six months. Two years before the authors saw him he noticed a lump in the lateral chest wall and this gradually increased to the size of a lemon. Operative removal showed it to be a cyst in the superficial soft tissues and it was found to be lined with pseudostratified ciliated columnar epithelium, stratified squamous epithelium and granulation tissue. It contained a jagged sliver of steel free within its lumen.

In speculating as to the manner in which it came to be lined with mature bronchial epithelium, they suggest that it may represent a remnant of a bronchopleural-subcutaneous fistula or that bronchial epithelium may have been carried to its definitive site by the jagged projectile.—*A. E. Childe, M.D.*

CHURCH. R. E., and ELLIS, A. R. P. Cystic pulmonary fibrosis in generalized scleroderma; report of two cases. *Lancet*, March 4, 1950, *1*, 392–394.

Although early generalized scleroderma constitutes a dermatologic condition, affection of the internal organs is recognized. Scleroderma is a disease of the connective tissue as a whole and can include the lungs. Formerly the dyspnea was explained on the basis of sclerosis of the skin and muscles of the chest wall but now it is admitted that fibrotic changes in the lungs actually exist producing the symptoms.

The authors present 2 cases of scleroderma that not only show pulmonary fibrosis but cystic changes as well. Only 3 other cases with concomitant cystic changes have been described in the literature and those by Dostrovsky.

In obscure fibrotic lung conditions scleroderma should be considered in the differential diagnosis.—*A. F. Rossitto, M.D.*

SUSMAN, M. P. The treatment of pulmonary hydatid disease. *J. Thoracic Surg.*, March, 1950, *19*, 422–432.

Susman agrees with most Australian surgeons that pulmonary resection is not the treatment of choice in hydatid disease of the lung. He recommends lobectomy only if there is serious hemorrhage from a cyst during a conservative operation, residual bronchiectasis, empty sac with infection or hemorrhage, a questionable diagnosis or giant-cyst. All other cysts are treated conservatively with evaluation of the cyst contents, removal of the membrane and drainage if indicated.

Eighteen roentgenograms of the chest before and after surgery are included and 7 cases presented in detail.—*Martha Mottram, M.D.*

SAMSON, P. C., HEATON, L. D., and DUGAN, D. J. Mediastinal "tuberculoma"; surgical removal in four patients. *J. Thoracic Surg.*, March, 1950, *19*, 333–348.

The authors summarize the available information in the literature on "tuberculomas" of the mediastinum and report 4 additional cases of their own, making a total of 8. All these lesions were granulomas and presented a similar picture of fibrosis, round cell infiltration, epithelioid cell reaction, multinucleated giant cells, and varying degree of caseation necrosis. In all but one instance there was residual lymphoid tissue. A few acid-fast bacilli were found by special staining methods in only 1 case. No tubercle bacilli were demonstrated in the remaining 7 so it is felt that their tuberculous nature has not been unquestionably proved.

Three patients had no complaints but the other 5 suffered from such symptoms as dyspnea, cough, pain and dysphagia. They uniformly mimicked more commonly encountered lesions. Some contained scattered calcification but this resembled that found in teratoid tumors. None were correctly diagnosed preoperatively, and it is concluded that accurate diagnosis before exploration is difficult. In 4 cases the masses were in the right posterior superior mediastinum, in 3 cases in the left anterior superior mediastinum and in the final case the mass was in the right posterior inferior mediastinum.

When such a granuloma is diagnosed at surgical exploration removal should be carried out whenever possible.—*A. E. Childe, M.D.*

FISCHER, F. K. Beitrag zur Kenntnis der Veränderungen im Brochogramm bei chronischer Bronchitis. (Contribution to the knowledge of bronchographic changes in chronic bronchitis.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, April, 1950, *72*, 653–659.

In chronic bronchitis, the bronchial mucosal glands are dilated by retained secretions. By

using a water soluble contrast medium which mixes with the bronchial secretions and enters the bronchial glands, the changes in the glands can be demonstrated. The dilated ducts of the glands appear as fine serrations along the lumen of the bronchi. These are most commonly seen in cases of bronchiectasis where, in addition, one may also see irregularity of bronchial filling and a zone of small, rounded filling defects lying parallel to the bronchial lumen.

Four cases are presented with their bronchograms.—*F. M. Reis, M.D.*

Deboo, S. N. Modern trends in the diagnosis of bronchogenic carcinoma. *Indian J. Radiol.*, Feb., 1950, *4*, 15–30.

The modern diagnostic methods employed in the diagnosis of bronchogenic carcinoma are: (1) roentgenological methods; (2) examination of sputum and pleural fluids; (3) examination of bronchoscopically removed secretions; (4) bronchoscopy and biopsy; and (5) exploratory thoracotomy.

The roentgenological methods are mainly five: (1) fluoroscopy and teleroentgenograms; (2) penetrating views with the Potter-Bucky diaphragm; (3) tomography; (4) bronchography; and (5) angiocardiography. The author describes the value and limitation of all these roentgenological methods. He stresses the advantages of tomography as compared to the more routine types of roentgenological investigation.

The author concludes by stating that the diagnosis of bronchogenic carcinoma is a matter of the most careful cooperation between the radiologist, the bronchoscopist and the pathologist using all the available methods of examination.—*F. J. Rigos, M.D.*

Brea, Mario M. J., Aguilar, Francisco, and Santas, Andrés A. Adenomas bronquiales; estudio clinocorradiológico y relato de 6 observaciones. (Bronchial adenomas; clinicoroentgenological study and report of six cases.) *Prensa méd. argent.*, March 3, 1950, *37*, 412–437.

The authors deal in extenso with the (1) history and bibliography, (2) pathology, (3) clinical diagnosis, (4) roentgenologic findings, (5) endoscopy and (6) treatment of bronchial adenoma. They also report 6 personally observed cases using roentgenograms, bronchograms, laminagrams, photographs of specimens and photomicrographs for illustration.

As a result of their exhaustive study the authors arrived at three important conclusions. (1) There is a divergence of opinion as to the origin and nature of bronchial adenoma. Most investigators consider it as arising from the epithelium of the bronchial glands, although if one accepts Stout's hypothesis of the origin from Hamperl's oncocytes, the term of "oncocytoma" would be more appropriate for its designation. In general, the tumor behaves as a benign lesion, but not infrequently there is invasion of the neighboring structures and rarely metastases via the lymph or blood stream also occur. The local malignancy is due mainly to anatomo-functional factors, such as impaired ventilation of the affected lung, mechanical obstruction and secondary infection.

(2) The diagnosis usually encounters no difficulty. A roentgenologically demonstrated benign bronchial obstruction in the majority of cases is synonymous with bronchial adenoma. Bronchoscopic biopsy then serves to confirm the diagnosis.

(3) The treatment is individual, the choice being between conservative bronchoscopic resection and radical pulmonary resection. It is a good policy to start with the former. In some cases as, for example, the polypoid and purely intrabronchial lesions, this may lead to complete success. In others, it prepares the ground for a more extensive intervention and in still others it may constitute the only palliative measure available. The radical operation, as a rule, consists of partial resection of the lung or complete lobectomy.—*T. Leucutia, M.D.*

Keil, P. G., Voelker, C. A., and Schissel, D. J. Diagnostic value of pulmonary arteriography in bronchial carcinoma. *Am. J. M. Sc.*, March, 1950, *219*, 301–306.

It is the purpose of the authors in this study to show that certain atypical pulmonary vascular patterns are associated with bronchial carcinoma. They state that injection of the pulmonary arterial tree of normal lungs with vinyl acetate demonstrates this arterial network to be rather uniform and extremely compact with major branches closely associated with the large bronchi. A neoplasm anywhere would be expected to alter this pattern.

The technique employed is a posteroanterior projection of the chest with a target film distance of 6 feet. A multiple cassette changer is employed although there are no details as to the exact nature of the mechanism used. The

usual chest film kilovoltage is increased by 10. After the injection of 50 cc. of 70 per cent diodrast films are made at two, four, six and eight seconds after completion of injection.

The authors present 15 patients with pulmonary parenchymal disease ultimately proved to have bronchial carcinoma who were studied by angiocardiography. The most constant abnormality was diminished vascularity of all or part of the lung distal to the carcinoma. In addition, decreased caliber, distortion, or actual arterial occlusion of secondary radicles within the tumor mass was seen in 9 cases; 2 showed displacement and distortion of the main pulmonary trunk. One shows complete obstruction of a major part of the right pulmonary artery. The 1 case without a deviation from the normal vascular pattern had diffuse lymphangitic spread of carcinoma throughout the entire lung prior to the development of a mass in the right hilar region.

In no instance was the pattern of diminished vascularity present in a purely inflammatory lesion. Diminished vascularity is seen in senile emphysema and in bullous emphysema. In both, there is ordinarily no tumefactive process present. Within a cavity no vascular pattern is visible while the area around the abscess shows either some increase in vascularity or no changes. The area distal to the abscess shows no disturbance of the vascular pattern.

The authors believe that the diminished vascularity is due (1) to vascular occlusion, (2) to partial bronchial obstruction with resultant segmental or lobar obstructive emphysema, and (3) to necrosis of lung parenchyma with avascularity. The first appears to be the constant finding, no matter where the neoplasm is located.—*H. H. Galston, M.D.*

KROSS, ISIDOR. Tuberculoma of the lung, simulating bronchogenic carcinoma. *Am. Rev. Tuberc.*, March, 1950, *61*, 431–435.

On routine chest examination a sharply circumscribed shadow of increased density was recognized in the right upper lobe of an asymptomatic adult male. A film three years earlier had been negative. A film four months later showed an increase in the size of the shadow, and tomograms six months later showed a central area of necrosis. Bronchoscopic examination and sputum examinations for acid-fast bacilli were negative. Although originally thought to be a tuberculoma, the increase in the size of the lesion under observation and the roentgenographic appearance suggested that this was a bronchogenic carcinoma and the lung was removed.

Pathologically, the lesion proved to be tuberculous, with central caseation, with acid-fast bacilli readily demonstrable in smears from the caseous area.

The literature is briefly reviewed to emphasize that no general rules for preoperative diagnosis of such lesions can be made.—*Lois Cowan Collins, M.D.*

SHEFTS, L. M., and HENTEL, W. Bronchogenic carcinoma and pulmonary tuberculosis. *Am. Rev. Tuberc.*, March, 1950, *61*, 369–386.

Three cases of co-existing pulmonary tuberculosis and bronchogenic carcinoma, 2 cases of bronchogenic carcinoma stimulating tuberculosis, and 1 case of tuberculosis simulating bronchogenic carcinoma are reported.

The limitations of preoperative diagnostic methods are recognized, but a few signs which might suggest co-existence of carcinoma and tuberculosis are enumerated. The possibility of either lesion predisposing to the other is discussed; the possibility of extensive tuberculosis being antagonistic to the development of primary carcinoma is considered untenable.

In reviewing the literature concerning co-existence of the two conditions, the authors comment on the likelihood of one lesion being overlooked when the other is predominant.—*Lois Cowan Collins, M.D.*

JONES, E. M., PECK, W. M., WOODRUFF, C. E., and WILLIS, H. S. Relationships between tuberculosis and bronchiectasis; a study of clinical and of post-mortem material. *Am. Rev. Tuberc.*, March, 1950, *61*, 387–398.

Study of the relationship between bronchiectasis and primary type pulmonary tuberculosis was approached by doing bronchograms on 34 children who had had primary tuberculosis and bronchoscopic evidence of bronchial obstruction. The studies were made an average of $3\frac{1}{2}$ years after clearing of the pulmonary lesions. In 24 of these cases bronchiectasis was demonstrated; it tended to be co-extensive with the bronchus and cylindrical from root to periphery. This led to the assumption that anatomical or physiological obstruction from endobronchial disease, or pressure from enlarged tracheobronchial lymph nodes, are the responsible factors.

The reinfection tuberculosis cases were stud-

ied by doing postmortem bronchograms on 100 lungs of tuberculous patients. In this group 46 per cent were found to have bronchiectasis, but in only a few was the bronchiectasis of the cylindrical segmental type due to bronchial obstruction, as observed in association with the primary tuberculosis. The majority were localized patchy areas of ectasia, peripheral in location, corresponding to the distribution of the tuberculous lesions. Disease was invariably present in the wall of the affected bronchi and was undoubtedly the major factor in the development of ectasia, although extrinsic factors such as fibrosis were sometimes present, and may have participated in the process to some extent.—*Lois Cowan Collins, M.D.*

Geever, E. F., and Stone, W. F., Jr. Fatal asphyxia as a complication of lucite plombage. *Am. Rev. Tuberc.*, March, 1950, *61*, 422–425.

A thirty year old male was treated for pulmonary tuberculosis by extrapleural lucite ball plombage in an attempt to close a large apical cavity. Postoperatively extrapleural infection occurred, with resultant formation of bronchoextrapleural fistulas, demonstrated by bronchography. Sixteen months after the operative procedure, one lucite ball eroded through the lateral wall of the trachea, and caused death by asphyxia. The margins of the eroded tracheal wall showed fresh tuberculous granulation tissue.—*Lois Cowan Collins, M.D.*

Eggenschwyler, H. Schalenförmige Hilusverkalkungen ohne Silikose. (Shell-shaped hilar calcifications without silicosis.) *Radiol. clin.*, March, 1950, *19*, 77–81.

Sweany in 1936 coined the name of "egg-shells" for the designation of peculiar hilar calcifications which on roentgenologic examination appeared as multiple rings at the periphery of moderately enlarged lymph nodes and which anatomically corresponded to subcapsular calcification zones. Since then, these shadows were considered by various investigators as being indicative either of silicotuberculosis (Sweany, Vigliani) or of pure silicosis (F. Lommel, Schairer, Riemer, Zanetti).

The author reports a case of typical egg-shell calcifications without exposure to silica dust. The case is that of a woman seventy-three years old who from the age of fourteen to fifty-three years worked at a sorting machine in a dust-free silk factory and after that occupied herself as a housewife and cultivating a rather large garden. The calcifications occurred in the lymph nodes of both hilar regions as well as in the lymph nodes of both sides of the neck. Smaller, lentil-shaped foci were also observed in the intrapulmonary lymph nodes of both upper lobes and of the left parahilar region.

The opinion is expressed that these calcifications represent the final stage of a tuberculous infection and that, therefore, the demonstration of egg-shell shadows on the roentgenograms cannot be regarded as a certain proof of silicosis.

Two roentgenograms illustrating the typical appearance of egg-shell calcifications are reproduced.—*T. Leucutia, M.D.*

Roberts, John C., and, Blair, L. G. Bronchiectasis in primary tuberculous lesions associated with segmental collapse. *Lancet*, March 4, 1950, *1*, 386–388.

This article presents the investigation in the incidence of pulmonary collapse and the incidence and etiology of bronchiectasis in this group. In 400 cases of primary tuberculous lesions, 77 showed collapse of a segment, lobe or a lung. By bronchography or plain roentgenogram 46 (60 per cent) of the 77 cases were diagnosed bronchiectasis. The remaining 31 were negative to bronchiectasis.

Seven references, and their authors, are quoted in the possible causative factors in bronchiectasis, namely, effect of collapse alone, effect of increased negative pressure, distention of bronchi, loss of elasticity of bronchial wall and inflammation of bronchi. These aspects were investigated.

The authors conclude that (1) collapse in itself is insufficient to produce bronchiectasis; (2) in segmental collapse with free pleura negative intrapleural pressure plays no part in producing bronchiectasis; (3) distention with loss of elasticity of bronchial wall and secondary infection of bronchi are important in producing bronchiectasis.

Symptoms and treatment are mentioned. In primary tuberculous lesions with pulmonary collapse symptomless bronchiectasis may develop. Collapse occurs as a result of extrinsic pressure due to enlarged lymph nodes or from infiltration of bronchial wall. Distention of bronchi beyond obstruction takes place by mucus, tuberculous material or by secondary infection. The latter commonly produces symptoms.

Mantoux test, gastric washings and bronchos-

copy are recommended for diagnosis.

Secondary infection should be treated energetically by bronchoscopic suction, postural drainage, care of upper respiratory source, and drugs (streptomycin).

If lobectomy is indicated and a primary tuberculous lesion is present, two years should elapse after resolution of process.—*A. F. Rossitto, M.D.*

SIMON, G. The x-ray appearances of acquired atelectasis of the upper lobes. *J. Faculty of Radiologists*, April, 1950, *1*, 223–230.

Typically in atelectasis of the right upper lobe the diaphragm is not elevated. There is little or no displacement of the heart and trachea toward the right. A homogeneous shadow is seen in the right upper lung zone reaching to the apex with a characteristic inferior concave margin—representing the collapsed lobe. An important feature is the abnormality of the vascular markings in atelectasis. The upper lobe vessels are swung upwards and become invisible in the dense shadow of the collapsed lobe, resulting in non-visualization of the usual first division of the main vascular stem. The lower lobe vessels become abnormally spread out. While these features may be seen on an ordinary film they are more clearly brought out by tomography. In the right lateral view the collapsed lobe usually presents a triangular shadow, with apex toward the hilus. One must distinguish such collapse from a mediastinal tumor, apical pleural thickening and the sail-like shadow sometimes seen in the right upper lobe due to the thymus. The latter will have a well defined horizontal lower margin whereas the inferior margin of the atelectatic upper lobe tends to be concave.

There is some difference in the roentgen appearance between atelectasis of the right and left upper lobes. In the latter the lingula segment is always involved, hence in frontal projection the shadow is larger and tends to lie in the medial half of the lung field, with very poorly defined lateral and inferior margins. In the lateral view the collapsed lobe tends to lie anteriorly with the most usual appearance that of a tongue-like shadow with the apex projecting downward. The shadow of the collapsed lobe may be in apposition anteriorly with the sternal shadow or it may lie 1 to 2 cm. posterior to the sternum, depending upon the degree of collapse. A less shrunken lobe must be distinguished from a consolidated upper lobe by a posterior concave margin lying anterior to the normal line of the interlobar fissure.—*S. G. Henderson, M.D.*

LINDSKOG, G. E., and ALLEY, R. D. Bilateral bronchiectasis; an analysis of forty-three consecutive cases. *Arch. Surg.*, March, 1950, *60*, 465–472.

Forty-three cases of bilateral bronchiectasis, all proved by bronchography, were observed at the thoracic surgical service of the New Haven Hospital during a nine year period, January 1, 1939, to January 1, 1948. This period witnessed the transition from the technique of mass ligation to that of individual ligation in the handling of the hilus, the discovery and general use of penicillin, the development of blood banks and important advances in anesthetic technique.

Twenty-six of the 43 cases were selected for surgical treatment and 20 accepted treatment. Twelve of the 20 surgical cases have undergone bilateral operations. Of these, 8 have negligible or no symptoms and 4 have minimal or moderate symptoms. In only 6 of the entire group has total excision of all of the diseased area by technique of individual ligation been performed. Of the 8 patients who have undergone unilateral resection, all but one improved. Five of these 8 are under consideration for contralateral surgical procedures.

Details of operative procedure are discussed. There were no deaths in this series of thirty-three resections in 20 patients with bilateral bronchiectasis.—*C. P. Truog, M.D.*

ANGERER, H., and RAVELLI, A. Zur Röntgendarstellung traumatischer Aneurysmen. (Roetngen visualization of traumatic aneurysms.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, April, 1950, *72*, 718–722.

The pathogenesis and roentgenologic features of various types of traumatic aneurysms are discussed.

The authors used 10–20 cc. of perabrodil or uroselectan, which is injected percutaneously into the aneurysm while compression is applied to the blood vessels, proximal and distal to the aneurysm. Information as to the size and position of the aneurysm as well as its relations to the neighboring structures can be gained. One can also learn about its content, and the character of the wall, which enables one to estimate the degree of maturity of the aneurysm. The collateral vessels can often be delineated. The

type of aneurysm, especially the arteriovenous aneurysm, cannot be always determined.—*F.M. Reis, M.D.*

Klein, Arthur, and Porter, William B. Syphilitic aneurysm of the aorta with rupture into the pulmonary artery. *Am. Heart J.*, March, 1950, *39*, 465–472.

Rupture of an aneurysm of the ascending or transverse portion of the aortic arch into the pulmonary artery is not a rare occurrence. Patients with such a condition present a fairly typical syndrome consisting of: (1) severe dyspnea; (2) preponderance of right ventricular failure; (3) a purring systolic and diastolic thrill arising in the pulmonic area; (4) harsh systolic and diastolic murmurs originating in the same region; (5) the peripheral signs of aortic insufficiency; (6) physical and roentgenographic evidence of aneurysm of the ascending or transverse aorta; and (7) appearance of right axis deviation in the electrocardiogram.

The case discussed was a forty year old white male with sudden onset of dyspnea and cough and most of the classic signs of the entity under consideration. In addition, the patient was studied by right heart catheterization and two important phenomena thus observed: (1) a definitely increased oxygen saturation of the pulmonary artery blood as compared to the right auricular and right ventricular blood and, (2) increased pressure in the pulmonary artery as compared to the pressure in the right ventricle. These aberrant findings could only be produced by a large shunt of arterial blood into the pulmonary artery such as would occur with a patent ductus arteriosus or in rupture of the aorta into the pulmonary system.

In this case the diagnosis of aortic aneurysmal rupture into the pulmonary artery was confirmed by postmortem examination fourteen months after the onset of the patient's symptoms, there being a fusiform syphilitic aneurysm of the ascending aorta with rupture into the main pulmonary artery.—*Harold Fulton, M.D.*

Temple, L. J. Aneurysm of the first part of the left subclavian artery; review of the literature and a case history. *J. Thoracic Surg.*, March, 1950, *19*, 412–421.

Temple presents a short summary of the reported cases of aneurysm of the first part of the left subclavian and the difficulty of repair. The usual operative approach is anterior and superior with division of the clavicle and sternum. Temple in his case did a posterior thoracotomy which gave easy exposure and he found the operation by this method to be "relatively simple."

His patient had an injury to the chest and shortly thereafter developed a Horner's syndrome. There were no complaints, but a film showed a large smooth ovoid mass filling the entire left upper chest down to the level of the third rib anteriorly. There were no pulsations or tumor mass palpable in the neck, as is usual. The mass did not pulsate (only 25 per cent reported to show pulsation) and no vascular abnormalities in the arm were noted.

The collateral circulation after ligature of the first part of the left subclavian is mentioned briefly.—*Martha Mottram, M.D.*

Felson, Benjamin, Cohen, Sander, Courter, Sanford R., and McGuire, Johnson. Anomalous right subclavian artery. *Radiology*, March, 1950, *54*, 340–349.

One of the most common anomalies of the great cardiac vessels is a right subclavian artery which originates in the descending aorta rather than from its usual location on the right. This variation has been recognized pathologically for about two centuries but with the advent of surgical treatment of congenital cardiac abnormalities more attention is being paid to this unusual vessel.

From 0.4 to 2% of all cases of congenital heart disease have this great vessel variation. Usually this condition produces no symptoms but dysphagia from pressure on the esophagus may occur.

Nine cases are reported showing a pressure defect on the esophagus just above and opposite to the normal aortic impression. This defect is caused by the anomalous right subclavian artery as it passes upward behind the esophagus. The defect is therefore oblique in relation to the barium-filled esophagus and extends from the left inferior to the right superior aspect.

None of the 9 patients had symptoms and there was therefore no surgical proof. However, the roentgenograms are identical to other proved cases.—*C. A. Stevenson, M.D.*

Knutson, J. R. B., Taylor, B. E., Pruitt, R. D., and Dry, T. J. Anomalous pulmonary venous drainage diagnosed by catheterization of the right side of the heart; report of three cases. *Proc. Staff Meet., Mayo Clin.*, Feb. 1, 1950, *25*, 52–59.

Anomalous drainage of the pulmonary veins into the right side of the heart is discussed by the authors with particular reference to the findings on cardiac catheterization. They do not believe that it can be diagnosed accurately by the usual clinical methods.

Incomplete drainage is twice as common as complete, and anomalous drainage of the right pulmonary veins is more frequent than that of the left. Complete drainage of all pulmonary veins into the right side of the heart is only compatible with life if there is a functionally patent defect in the atrial septum. Incomplete drainage does not appear to decrease longevity.

The altered physiology is similar to that produced by an atrial septal defect. There is increased oxygen saturation of the right heart blood, increase in pulmonary flow with engorgement of the pulmonary vascular tree and right ventricular hypertrophy.

Routine roentgenograms in the 3 cases studied by the authors revealed enlargement of the right ventricle, prominent outflow tract, and small hypoplastic aorta. Roentgenoscopy demonstrated prominent pulsating pulmonary arteries.

On catheterization of the right side of the heart high oxygen saturation was found and on two occasions they actually entered the pulmonary vein from the superior vena cava and obtained blood with an oxygen saturation of 100 per cent.

Surgical therapy was not attempted because of the statistically favorable prognosis.—*R. A. Hays, M.D.*

TAYLOR, B. E., KNUTSON, J. R. B., BURCHELL, H. B., DAUGHERTY, G. W., and WOOD, E. H. Patent ductus arteriosus associated with coarctation of the aorta; report of 2 cases studied before and after surgical treatment. *Proc. Staff Meet., Mayo Clin.*, Feb. 1, 1950, *25*, 62–68.

Patent ductus arteriosus occurs in about 10 per cent of the cases of adult coarctation of the aorta and its preoperative recognition is desirable.

Clinically the association may be suggested by the presence of a diastolic murmur over the base of the heart. This could be due to insufficiency of a bicuspid aortic valve. The authors reason that catheterization of the right side of the heart can give definite proof of the presence of a patent ductus. The characteristic finding is the increase of the oxygen saturation of the blood in the pulmonary artery over that in the right ventricle.

The opening of the ductus in the aorta may be proximal or distal to the coarctation. In 1 of the 2 cases presented by the authors, the opening was distal to the coarctation. In cases of this type the flow of blood may be retrograde from the pulmonary artery to the aorta so that unoxygenated blood is supplied to the lower part of the body. The usual roentgen signs of notching of the ribs will be absent because extensive collateral circulation is not developed. Marked right ventricular hypertrophy may be expected because systolic blood pressure will be the same in the pulmonary artery and aorta.—*R. A. Hays, M.D.*

MORGAN, E. H., and BURCHELL, H. B. Ventricular septal defect simulating patent ductus arteriosus. *Proc. Staff Meet., Mayo Clin.*, Feb. 1, 1950, *25*, 69–73.

The authors present a case to illustrate the advantage of preoperative catheterization of the heart prior to surgery in cases of patent ductus arteriosus.

The clinical findings in cases of patent ductus and ventricular septal defect are frequently quite similar. The results of cardiac catheterization which was done routinely prior to surgery for patent ductus to learn the pulmonary arterial pressure and the amount of shunt, revealed high oxygen content of the right ventricular blood. This observation in the absence of gross pulmonary insufficiency signifies a ventricular septal defect or its equivalent.

On review of the clinical examination in their case which was diagnosed as a patent ductus, the authors found that the systolic accentuation of the murmur preceded the upstroke of the carotid pulse. In cases of proved patent ductus the two had been found synchronous.—*R. A. Hays, M.D.*

FRIEDMAN, CARL-ERIC. The residual blood of the heart. *Am. Heart J.*, March, 1950, *39*, 397-404.

The residual blood is that volume of blood remaining in the heart cavities after systole. No opinion can be offered by the author as to the presence of residual blood in normal hearts; residual blood is present in diseased hearts and it is almost certain that changes in its amount are very closely related to the degree of cardiac dilatation. In a dilated heart a certain volume of blood is retained after every contraction and

this inactive blood causes the heart to start the next systole in a state of preliminary tension.

Six patients with decompensated rheumatic valvular disease and considerable cardiac enlargement were studied by means of teleroentgenograms and application of the Rohrer-Kahlstorf formula for heart volume. The same patients' hearts were examined postmortem by comparable teleroentgen technique. The difference of the heart volume before and after death plus the residual blood postmortem approximates the amount of antemortem residual blood. During life all of these patients' hearts contained considerable quantities of residual blood (ranging from 300 to 1,000 cc.).

As further check on the accuracy of the teleroentgenographic method of volume determination used, the volume displacement law was applied to the hearts at autopsy, and close correlation between the results of the two methods was found.—*Harold Fulton, M.D.*

Sahn, Stanley H., and Levine, Ida. Pulmonary nodules associated with mitral stenosis. *Arch. Int. Med.*, March, 1950, *85*, 483–489.

Two cases of pulmonary nodules associated with mitral stenosis are presented. The first patient exhibited soft areas of infiltration and the second the calcific areas of density. These are caused by a combination of hemosiderosis, fibrosis, chronic congestive changes and engorged vessels, with the calcification and ossification representing a more extreme reaction to the degenerative changes.

It is the opinion of the authors that the condition is more frequent than is indicated by the number of cases reported in the literature.—*V. L. Peterson, M.D.*

Innerfield, Irving. Lutembacher's syndrome associated with dextrocardia. *Arch. Int. Med.*, March, 1950, *85*, 490–495.

A case of interauricular septal defect combined with mitral stenosis associated with dextrocardia is reported. The roentgenogram is shown demonstrating a dextrocardia, a greatly enlarged right ventricle, a small aorta, a markedly prominent pulmonary artery and engorged hilar vessels. Fluoroscopic examination and a venous catheterization confirmed the diagnosis.

The electrocardiogram revealed right axis deviation and an interventricular conduction defect.

The case is unusual since it is the only case reported in the literature combining Lutembacher's syndrome and dextrocardia.—*V. L. Peterson, M.D.*

Peabody, G. E., Reader, G. G., Dotter, C. T., Steinberg, I., and Webster, B. Angiocardiography in the diagnosis of cardiovascular syphilis. *Am. J. M. Sc.*, March, 1950, *219*, 242–248.

Angiocardiography is a roentgen technique which aids in the confirmation or exclusion of the clinical diagnosis of cardiovascular syphilis. Although the active syphilitic process underlying and preceding cannot thus be revealed, early gross anatomical changes resulting therefrom are rendered clearly perceptible. Angiocardiography may prove to be of particular value in the early diagnosis of cardiovascular syphilis in the clinically latent period of late syphilis where the incidence of syphilis of the cardiovascular system is high.

The best available means of diagnosing cardiovascular syphilis in the past has been through history taking, physical examination and chest roentgenography. As the condition in its early stages is fundamentally symptomless, without signs and not apparent by roentgen study of the chest, early diagnosis is usually not possible. Sussman, while analyzing the importance of the roentgenologic examination on such matters as dilatation and increased density in the syphilitic aorta, stated that definite deviations from the normal were indicative of disease but that minor deviations were of no significance.

The method employed by the authors is that as reported by Robb and Steinberg using the left anterior oblique position at a 6 foot target film distance. Measurements made of 100 normal aortas by angiocardiography, including those showing atherosclerotic changes, showed the maximum caliber of the mid-ascending aorta in non-syphilitic individuals to be 38 mm. A study of 61 angiocardiographically visualized aortas previously reported revealed the following characterstic changes in syphilitic aortitis: (1) dilatation of the mid-ascending aorta beyond 38 mm.; (2) irregularity of the lumen of the ascending aorta; (3) variations in the thickness of the aortic wall; (4) calcification of the ascending aorta; (5) tortuosity of the aorta. Although dilatation of the aorta may also be caused by hypertension, atherosclerosis, rheumatic aortic vavular insufficiency and coarcta-

tion, it would appear that this complex of findings mentioned above is indicative of syphilitic aortitis and nothing else.

Ninety-three patients at the New York Hospital, including 83 with late syphilis, were studied as to the relative merits of physical findings, conventional chest roentgenography and angiocardiography in the clinical diagnosis of cardiovascular syphilis. By angiocardiography alone the diagnosis of cardiovascular syphilis was effected in 15, excluded in 9 and sustained in 17 in which chest roentgenography was negative.—*H. H. Galston, M.D.*

ABDOMEN

MACHT, STANLEY H. Modified technic for cholangiography and use of a new contrast medium (rayopake) for visualization of the biliary tree. *Radiology*, March, 1950, *54*, 421–423.

The author advocates rayopake rather than lipiodol or diodrast for cholangiography. The advantages claimed for his choice are high viscosity as compared to diodrast and water solubility as compared to oily lipiodol.

The patient is placed on the roentgenographic table in a 30 degree Trendelenburg position. The external portion of the "T" tube is clamped and 10 cc. of the opaque medium injected via needle puncture into the rubber tube. Air bubbles are thus eliminated. Exposures need not be made in a great hurry because the viscosity of the medium prevents rapid flow into the duodenum.—*C. A. Stevenson, M.D.*

STEWART, JOHN S. The roentgenologic manifestations of parasternal omental hernia. *J. Thoracic Surg.*, March, 1950, *19*, 399–404.

Although this is a rare condition it should be considered in the differential diagnosis of masses at the cardiophrenic angle on either side. It occurs more frequently on the right side where a sac of peritoneum containing a portion of the omentum herniates through the foreman of Morgagni. It should be considered in the differential diagnosis which includes lymphomas, teratomas, lipomas, neurofibromas, aberrant thyroids, celomic cysts and peripheral lung neoplasms. This paper deals with the preoperative diagnosis in 3 cases and stresses the cardinal signs of the presence of a mass which moves with the diaphragm, upward displacement of the transverse colon which often forms an inverted "V" or "U" and in the lateral view is displaced much more anteriorly than usual. He also adds a new method of diagnosis which consists of pneumoperitoneum and the demonstration of air within the hernial sac.

Operation is indicated when these lesions produce symptoms which usually mimic those of gallbladder disease.—*R. P. Barden, M.D.*

BARTLETT, J. P., and ADAMS, W. E. Generalized giant hypertrophic gastritis simulating neoplasm; differential diagnosis and report of a case. *Arch. Surg.*, March, 1950, *60*, 543–558.

The authors report a case and subsequently observed a second case, which are the only 2 cases of generalized hypertrophic gastritis treated by total gastrectomy prior to January, 1948. A concise summary of the literature on this subject is presented. Chemical, mechanical and thermal irritants have been indicated as etiologic factors.

Hypertrophic gastritis consists of hypertrophy and hyperplasia. Symptoms include upper abdominal pain, inconstantly relieved by food, and less often, one finds nausea, emesis, anorexia, weakness, weight loss, diarrhea and headache. Hemorrhage may occur. Obstruction is encountered, especially when polyps or redundant mucosal folds are present.

It is the experience of the authors that differentiation of hypertrophic gastritis from polypoid carcinoma, lymphosarcoma, multiple adenomatous polyps and less commonly from leiomyosarcoma, Hodgkin's disease, uncommon benign lesions and syphilis of the stomach by roentgenologic and gastroscopic examination is difficult or at times impossible. Every severe case of gastritis does not become cancer and all cancers of the stomach do not arise on the basis of chronic gastritis.

In general, it can be said that the pathologist shares with the radiologist, gastroscopist and surgeon, a modicum of uncertainty as he strives to correctly diagnose this condition. The premalignant nature of the lesion, the danger of break of suture line and the lowered mortality rate from total gastrectomy justify the latter procedure as an escape from symptoms to be expected in the natural course of the disease.—*J. W. Turner, M.D.*

GRIMES, O. F. and BELL, H. G. Clinical and pathological studies of benign and malignant gastric ulcers. *Surg., Gynec. & Obst.*, March, 1950, *90*, 359–371.

This is an excellent study of benign and malignant gastric ulcers. The authors point out

that despite the great success of present surgeons in solving the technical problems of gastric surgery there has been no significant increase in the number of five year survivals of patients who have been operated upon for carcinoma of the stomach.

The dependability of present diagnostic methods to distinguish benign from malignant gastric ulcers can justifiably be questioned. For example: (1) No less than 13 of the 24 malignant gastric ulcers whose study constitutes the central theme of this investigation were located along the lesser curvature. Thus, it must be accepted that an ulcer in any location in the stomach may be malignant. (2) Free acid is found almost as often in malignant as in benign ulcers. In this series of 24 malignant ulcers there was a total lack of free acid in only 5 patients. (3) In the group studied 17 of the 24 malignant ulcers (71 per cent) had a diameter of 3.0 cm. or less, while 74 of the 99 benign ulcers (75 per cent) were 3.0 cm. or less in diameter. Viewed from this perspective, the reliability of a distinction between benign and malignant ulcers with respect to size is extremely questionable. (4) Medical therapy almost always can ameliorate symptoms by abolishing associated gastritis even without complete healing of the ulcer. Of greater significance is the fact that although an ulcer may completely disappear, a microscopic focus of malignancy may be enclosed within the healing process. Moreover, these early carcinomatous foci are frequently of the highest grade of malignancy. Of special interest is the observation of Schindler, and more recently, Palmer, that healing, or at least a decrease in size of the ulcer crater, can occur by the infiltration of the lesion by malignant cells. Actual re-epithelization of the ulcer by proliferating malignant epithelium has been observed by Palmer.

Allen and Welch, reviewing 277 cases of gastric ulcer, were able to demonstrate that patients beyond the fifth decade who have symptoms one year or less are more likely to have cancer than ulcer. On the other hand, when symptoms are present for five years or longer, the reverse is true. It should be emphasized, however, that the incidence of benignity in any of the groups, arranged according to age and duration of symptoms, was not of sufficient magnitude to allow certainty of diagnosis in any individual case.

Conclusion. If the several investigative procedures yield equivocal results in the initial examination of the patient with gastric ulcer, immediate surgery should be undertaken. It must be acknowledged that medical treatment of gastric ulcers is often eminently successful. However, the concepts upon which a medically designed regimen are based are richly balanced by the greater certainty and clarity of diagnosis by surgical means so that in the final analysis the balance of judgment in the management of gastric ulcers must favor the surgical approach. —*Mary Frances Vastine, M.D.*

Levrat, M., Brette, R., Richard, M., and Fournier, M. Étude clinique et radiologique des ulcères de la face antérieure de l'estomac. (Clinical and roentgen study of ulcers of the anterior wall of the stomach.) *Arch. d. mal. de l'app. digestif.*, April, 1950, *39*, 417–428.

Ulcers of the anterior wall of the stomach are seldom encountered. This paper deals only with ulcers located 2 cm. or more from the curvatures and from the opening of the stomach. They represent less than 1 per cent of all ulcers of the stomach.

Four personal cases are discussed together with 12 others selected from various clinics in France. Most of the 16 ulcers belonged to the vertical portion of the wall of the stomach. Two of them were seen on the horizontal portion and 4 on the upper pole of the anterior wall. These ulcers adhere either to the diaphragm or to the left lobe of the liver and it is impossible to dissociate them from these adjacent structures. Ulcers of the lower vertical and of the horizontal portion are, on the contrary, usually free from adhesions and likely to perforate into the peritoneal cavity. Classical ulcer syndrome was found in only half of the cases, mostly in the ulcers of the horizontal and vertical portion of the stomach excluding the upper pole. These ulcers tend to bleed more frequently than ulcers elsewhere in the stomach.

Ulcers of the anterior wall of the stomach are difficult to demonstrate roentgenologically. They can only be brought out by lateral projection, by mucosal studies or by compression, and are diagnosed occasionally by indirect signs of perforation such as pneumoperitoneum. They must be searched for whenever, in the presence of a typical clinical syndrome, an ulcer has not been demonstrated elsewhere in the stomach, or when hemorrhage or perforation occurs. Because of diagnostic difficulties and greater probability of hemorrhage and perforation the prognosis is not as good as in other localiza-

tions. For the same reasons, surgery seems more often indicated, as the treatment of choice, save perhaps, for the ulcers of the upper pole of the stomach.—*J.-P. Jean, M.D.*

GRAYSON, CHARLES E., and KENNEDY, BAYLES R. Roentgen diagnosis of ruptured aneurysm of the abdominal aorta. *Radiology*, March, 1950, *54*, 413–416.

Although life expectancy in instances of ruptured aneurysm of the abdominal aorta is extremely short, it is possible to demonstrate this condition roentgenologically before death.

Three verified cases are reported in which the hematoma caused by the aortic rupture cast a soft tissue shadow obliterating the psoas and renal outlines. Calcification of the walls of the aneurysm was also visualized.

Abdominal aortic aneurysms occur below the level of the renal arteries and are usually atherosclerotic in origin. It is possible that the recognition of this vascular rupture, may, in a few instances, lead to surgical repair.—*C. A. Stevenson, M.D.*

HALLIGAN, EARL J., PERKEL, LOUIS L., and CATLAW, J. KENNETH. Duodenocolic fistula; report of five cases. *Am. J. Proctology*, March, 1950, *1*, 7–16.

Duodenocolic fistula may result from an ulcer of the second portion of the duodenum, but usually it results from a fungating, ulcerating adenocarcinoma which slowly perforates through the colon into the duodenum. Symptoms in addition to those of a duodenal ulcer or carcinoma of the colon, as the case may be, are diarrhea, fecal vomiting, foul eructations of gas, distention, rapid weight loss, weakness, severe macrocytic anemia, hypoproteinemia, avitaminosis, and dehydration.

Diagnosis is made or confirmed by barium enema which nearly always shows the fistulous tract and rapid filling of the duodenum and stomach with barium. The gastrointestinal series shows the ulcer and scarring and pooling of barium in the second portion of the duodenum, but rarely shows the fistulous tract if this resulted from a perforating duodenal ulcer.

Operation may be done in one or more stages, although the one stage operation is very severe for the average poor risk patient.

The one stage operation includes the resection of the right half of the colon, terminal ileum, the fistula and part of the duodenum with closed end-to-side anastomosis of ileum to colon and end-to-end anastomosis of duodenum (if the fistula is due to ulcer the duodenum may be repaired).

In the multiple stage procedure, the first stage of a simple ileocolostomy after division of the ileum usually corrects the diarrhea and disturbances of fluid and electrolyte balance and permits the patient to be prepared better for a block dissection. The block dissection consists of removal of the stomach, duodenum, head of the pancreas, right half of the colon and the terminal ileum. The end of the colon is closed, the jejunum is transected, the distal end brought up, the common duct and pancreatic duct implanted into it at different levels, the proximal end of the jejunum implanted end to side, well below the common duct and pancreatic anastomosis, so that the food and intestinal contents will not regurgitate into the biliary tract.

Five cases are reported with 3 having been proved by operation.—*R. K. Arbuckle, M.D.*

FRIEDMAN, JACK, and RIGLER, LEO G. A method of double-contrast roentgen examination of the small intestine. *Radiology*, March, 1950, *54*, 365–379.

The authors give a good review of the literature, explaining various past and current methods of examining the small bowel. They describe the triple lumen Miller-Abbott type tube with two balloons placed 25 cm. apart at the end. With balloons of fixed size obstructive pressures are maintained with 45 cc. of air injected into each balloon. Into the closed loop of bowel is injected 30 to 40 cc. of thin barium mixture and 150 to 200 cc. of air. Five indications for the use of the triple lumen tube for double contrast examination of the small bowel are given.

Eleven figures of roentgenograms showing the normal anatomy and six pathological conditions demonstrated by this method.—*E. E. Seedorf, M.D.*

ROUSE, M. O., and REYNOLDS, W. S. Tumors of the small intestine. *South. M. J.*, March, 1950, *43*, 247–251.

The importance of small bowel study is stressed for the possible early detection of tumors, the majority of which carry a poor prognosis even if they are resectable. There were 36 cases observed by the authors and the locations

of the tumors were as follows: duodenum 4, jejunum 6, ileum 23 and jejuno-ileum 3. The types of tumors studied were adenomas, myomas, hemangiomas, neurogenic tumors, carcinoids, carinomas, and sarcomas (all of which were lymphosarcoma). The most frequently observed was carcinoma which was seen in 22 cases and 14 of these were in the ileum.

The indications for small bowel study are listed as (1) melena and persistent occult blood, particularly with an unexplained anemia; (2) abdominal pain or tenderness, that cannot be satisfactorily explained in terms of lesions in the other abdominal viscera, and (3) altered bowel function, especially diarrhea.

Various methods of examining the small bowel are given. Some of those mentioned are the small bowel enema as described by Schatzki and the more recent iced saline barium meal technique as described by Weintraub and Williams.

In the differential diagnosis, the authors list numerous possibilities some of which are appendicitis, chronic or acute; other forms of small bowel obstruction such as intussusception, the most common cause of which is a small bowel tumor; volvulus, which can also be associated with a tumor; adhesions with partial obstruction and foreign bodies which include gallbladder calculi. Also listed are some inflammatory conditions which must be considered; namely, regional enteritis, tuberculosis and peptic ulcers. A short discussion is given on each of these.

There is a classification of tumors of the small bowel and one other table.—*J. G. Snead, M.D.*

BÖHM, F. Die röntgenologischen Erscheinungsformen der abgeheilten, ehemals geschwurigen Darmtuberkulose. (The roentgenologic appearance of healed, ulcerative tuberculosis of the intestine.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, April, 1950, *72*, 675–686.

Three cases of intestinal tuberculosis treated by chemotherapy (conteben) are discussed and the transition from the acute to the healed phase portrayed by excellent roentgen film reproductions. It is important to know the appearance of healed intestinal tuberculosis because many cases are asymptomatic and first seen in the healed phase.

The final changes depend on the degree of involvement of the bowel. Superficial ulcerations of the mucosa usually heal with almost no scarring, while involvement of the entire thickness of the bowel wall will heal with much scarring, deformity, adhesions and even obstruction.

The usual roentgen picture of healed intestinal tuberculosis is that of segmental loss of normal mucosal pattern, with coarsening and atypical course of the folds, patches of granular or even polypoid mucosa, localized stiffness and irregularity of the bowel wall. The bowel, especially the colon, is shortened and normal peristalsis is absent with resultant slow passage of the contrast material. A scarred, contracted, pouch-like cecum connected to the rest of the colon by a stiff, narrowed tube of bowel is characteristic. The ileocecal valve is usually gaping and scarred.—*F. M. Reis, M.D.*

HAWLEY, CHAPIN, and MITHOEFER, JAMES. Ileal prolapse. *Radiology*, March, 1950, *54*, 380–385.

Prolapse of the mucosa of the terminal ileum into the cecum presents a round, smooth filling defect similar to a large polyp or other smooth, spherical tumor.

Two cases are added to 4 in the literature. The roentgen findings in these 2 patients were polypoid tumor in the cecum. Surgical exploration revealed prolapse of the ileal mucosa into the cecum. No obstruction existed and therefore no surgical correction was undertaken.

The differential diagnosis is difficult between this condition and a polyp or benign tumor. The condition apparently causes no symptoms.—*C. A. Stevenson, M.D.*

GYNECOLOGY AND OBSTETRICS

NASH, A. B. An appraisal of the value of radiological diagnosis in obstetrics, based on fifteen years' personal experience. *Am. J. Obst. & Gynec.*, March, 1950, *59*, 475–481.

Pelvimetry. Actual method used was a combination of the Snow method and that described by McSweeney and Moloney. The examination is desirable at term or in the early stages of labor. In most instances, trial of labor is more accurate than pelvimetry concerning the ability of the head to engage in the pelvic inlet, except in the occasional rare case of obvious inlet contraction. Of course, the trial of labor is not used if the mid-pelvic and outlet measurements are questionable. Mid-pelvic

measurements have proved reliable and invaluable to the intelligent handling of the patient.

Placental visualization. The plastic filter technique is used routinely to visualize the placenta on all pelvimetry. The normal placental site can be visualized with accuracy in practically 100 per cent of all the cases. The operative cases of placenta previa have been correct in all instances.

Intrauterine fetal death. The usual signs of fetal death are again enumerated and an additional sign observed in 2 cases, first described by Roberts, the radiolucent collections of gas in the major vessels.

Cephalometry. Estimation of the size, circumference, and diameters of the fetal head have not been found to be consistently reliable. —*E. A. Addington, M.D.*

DANFORTH, W. C. Sarcoma of the uterus. *Am. J. Obst. & Gynec.*, March, 1950, *59*, 598–608.

This is a report of 14 cases, of which 9 were primary tumors and 5 were considered to have arisen in myomas. The author gives an extensive review of the pathology, both gross and histologic, of sarcomas of the uterus. Treatment consists of complete hysterectomy with removal of the adnexa and postoperative irradiation. It is uniformly a fatal disease.—*E. A. Addington, M.D.*

LONG, J. P., and MONTGOMERY, J. B. The incidence of ureteral obstruction in benign and malignant gynecologic lesions. *Am. J. Obst. & Gynec.*, March, 1950, *59*, 552–562.

To determine the frequency with which ureteral obstruction is encountered in patients with pelvic disease, the case histories and roentgenographic examinations of 379 patients were reviewed.

Ovarian Tumors. There were 32 patients who had ovarian tumors, which were, with one exception, larger than a four months' pregnant uterus. Urinary tract obstruction was found in 11 of 19 cases (57.8 per cent) of benign ovarian tumors, and in 9 of 13 cases (69.2 per cent) of malignant ovarian tumors. In the patients with malignant neoplasms, bilateral obstruction was more frequent than unilateral obstruction, whereas in the benign tumors unilateral obstruction was more frequent. There was 1 patient with a granulosa cell tumor who was found to have a right hydroureter and hydronephrosis, which could not be explained on the basis of size and location of the tumor; it is considered that the changes in the urinary tract (which disappeared four weeks after operation) were due to hormonal influence. There had never been function from the left kidney, either preoperatively or postoperatively, and this was considered as an unrelated finding.

Carcinoma of the Uterine Cervix. There were 62 of the 116 patients with cervical carcinoma who showed urinary tract obstruction on one or both sides. When these patients were grouped according to the Schmitz classification, it was noted that the incidence of urinary tract obstruction became greater in the more extensive lesions. There were 6 of 20 patients, in groups 1 and 2, who were found to have either unilateral or bilateral obstruction of the urinary tracts. These were studied during and after irradiation, and the changes were considered to be due to irradiation edema or fibrosis except in 1 instance, in which the obstruction was considered to be due to extension of the disease two years after the original treatment.

Adenocarcinoma of the Uterine Fundus. Hydronephrosis from adenocarcinoma of the fundus is less frequent than with the cervical lesions. In 16 patients studied by intravenous urography, before hysterectomy, 5 showed partial obstruction of one or both ureters. In 2 there was gross extension of the disease to the tubes and ovaries; in 1 there was an associated pelvic inflammatory disease and a fibromyoma of the uterus; in the other 2 patients the cause of obstruction was not apparent.

Pelvic Inflammatory Disease. In this study of 47 patients there was dilatation of the upper urinary tract in 23 patients (48.9 per cent). There were 10 of the 23 patients who had urinary tract symptoms.

Fibromyoma of the Uterus. There were 66 of 139 patients (47.5 per cent) who had obstruction of one or both urinary tracts. In 31 the obstruction was slight and not considered to be clinically significant. There were other cases with delay in drainage or ureteral displacement, but without obstruction to the outflow of urine. It is interesting to note that 21 of the patients with ureteral obstruction had an associated chronic pelvic inflammatory disease, found at the time of operation.

Prolapse of the Uterus. There were 11 of 23 patients with uterine prolapse who showed mild hydronephrosis and hydroureter, or delayed drainage from the urinary tracts. Only 1 patient

showed a marked degree of hydronephrosis.

The observation is made that in the group of patients with benign pelvic lesions, unilateral urinary tract dilatation occurred much more frequently on the right side. Similar findings have been noted by many investigators in the study of patients during pregnancy, and this suggests that the same mechanical factors may be responsible in both instances.—*R. Wigh, M.D.*

Gray, Charles M., Nix, H. G., and Wallace, A. J. Thoracopagus twins; prenatal diagnosis. *Radiology*, March, 1950, *54*, 398–400.

A case of thoracopagus twins, with roentgenologic diagnosis before delivery, is reported. The prenatal diagnosis was made on the following points: (1) both fetal heads in the same plane and at the same level, (2) unusual hyperextension of cervical spines, (3) an extremely narrow space between the lower cervical and upper dorsal spines, and (4) no change in relative positions after maternal movement and manipulation.—*A. W. Sommer, M.D.*

Van Herik, Martin, and Good, C. Allen. Comparative accuracy of the Chassard-Lapiné and recumbent positions in roentgen measurement of the pelvic outlet. *Radiology*, March, 1950, *54*, 392–397.

The authors have performed a series of experiments to determine the relative accuracy of the recumbent position and the position of Chassard-Lapiné in the roentgen measurement of the pelvic outlet. For the recumbent position, the patient lies supine on the table and the roentgen tube is angled 33 degrees toward the head. In the method of Chassard-Lapiné the patient straddles a cassette, then bends forward at the hips until a plane connecting the undersurface of the symphysis pubis and the ischial tuberosities is parallel to the cassette. The roentgen tube is centered perpendicular to the film.

Multiple roentgenograms of a disarticulated bony pelvis with attached sacrum were made using the above methods under varying conditions of pelvic position, angulation of the roentgen tube, and pelvis-to-film distance.

Measurements of the subpubic angle and the symphysis-biparietal distance were made from each roentgenogram and plotted graphically. It was found that slight variations in pelvic tilt or tube angulation produced marked distortion of the subpubic angle when the recumbent position was used. However, when the position of Chassard-Lapiné was employed, variations greater than those ordinarily encountered produced so minimal an error that they could easily be discounted. Therefore, the authors are convinced that the position of Chassard-Lapiné should be used routinely in the roentgen measurement of the pelvic outlet. —*E. M. Cooper, M.D.*

GENITOURINARY SYSTEM

Rieser, Charles, Fort, Chester A., and Moffett, J. Denny, Jr. Localized intrarenal cystic disease of the kidney. *South. M. J.*, Feb., 1950, *43*, 133–138.

The authors present the following classification of renal cysts which was suggested by Braasch and Hendrick in 1944:

(1) Retention or inflammatory cyst.
(2) Simple cyst—single, multilocular or hemorrhagic.
(3) Peripelvic (pyelogenic cyst).
(4) Parapelvic cyst.
(5) Cyst, secondary to renal pathologic changes (calculus, hypernephroma, tuberculosis, pyelonephritis, hematoma, and echinococcus).
(6) Polycystic kidney.

To this classification the authors add a seventh type, namely, localized intrarenal cystic disease of the kidney. By this they mean a condition in which there are single or multiple cysts localized in one area of the kidney. There is no communication between the cyst or cysts and the caliceal system. Arppoximately 25 per cent of this type of cyst contained malignant change.

The authors discuss the differential diagnosis between this condition and neoplasms of the kidney.

Cystic disease usually presents as its initial symptom gross painless hematuria, occurring secondary to rupture of a blood vessel from the pressure of an adjacent cyst. The hematuria is intermittent in type. They state that long intervals between the episodes of hematuria would favor the diagnosis of cystic disease. One of the characteristic features of malignant tumor of the kidney is the presence of fatigue, whereas patients with cystic disease do not offer this complaint. The red blood cells and hemoglobin are usually not decreased in cystic disease unless the hematuria has been

prolonged and excessive. Secondary anemia commonly exists with neoplasms, even in early cases. The low grade fever which is characteristic of tumor is not present in cystic disease unless there is secondary infection.

The authors state that each condition produces a space-occupying lesion arising from the parenchyma and one cannot differentiate cyst from tumor by pyelographic study.

Two case reports are presented. There are five pyelograms and three photographs of pathological specimens.—*J. G. Snead, M.D.*

ANDERSON, M. X., ROBERTS, H. G., and SMITH, E. T. Calcified cyst of the adrenal cortex without endocrine symptoms. *Radiology*, Feb., 1950, *54*, 236–241.

The authors give the clinical history, laboratory findings, and present five good roentgenograms of a calcified cyst of the adrenal cortex in a female Negro, aged twenty-two. Cysts of adrenal classified as (1) true cysts, (2) cystic adenoma, (3) cystic lymphangiomas, and (4) pseudocysts.

Roentgen diagnostic features are posteriorly placed abdominal ovoid tumefaction with small irregular areas of calcific appearance and often calcified wall.

Operative findings are reported and the gross and microscopic appearances of the specimen are described and illustrated with three figures.—*E. E. Seedorf, M.D.*

POWELL, N. B. Surgical emergencies caused by simple or solitary renal cyst. *J. Urol.*, Feb., 1950, *63*, 203–207.

Solitary cyst of the kidney is rare but its spontaneous rupture is still rarer. The author reports 2 cases seen within a year, both of which ruptured and produced surgical emergencies. He was able to find only 4 similar cases in the literature. The cause of these renal cysts has been thought by some to be on a congenital basis and by others as due to disturbance of blood supply. The condition is to be distinguished from congenital polycystic disease.

The salient points in the roentgenographic diagnosis of solitary cyst have been listed by Gutierrez as follows: (1) compression of the renal pelvis or one or more calyces, (2) change in axis of the kidney, (3) medial displacement of the ureter; (4) rotation of the renal pelvis up or down; (5) visualization of the shadow of the cyst; (6) crescent shape of pelvis or calyces; (7) calcification of the cyst; (8) visible psoas shadow through wall of cyst; (9) shadow of cyst anterior to kidney; (10) visualization of cyst through pyelovenous backflow.

The 2 cases seen by the author are reported in detail with illustrative film reproductions.—*R. M. Harvey, M.D.*

ARMSTRONG, C. P., HARLIN, H. C., and FORT, C. A. Leukoplakia of renal pelvis. *J. Urol.*, Feb., 1950, *63*, 208–215.

Ten per cent of cases of leukoplakia of the renal pelvis are accompanied by leukoplakia of the bladder. An ectodermal process develops in the renal pelvis where normally only mesodermal and entodermal structures are present. The end result resembles normal skin. Many investigators believe the condition is a precursor of malignancy.

Infection is almost always found in association with leukoplakia and must play a role in its etiology. Some authors believe the condition arises in aberrant ectodermal tissue.

The condition is seldom diagnosed correctly preoperatively. The diagnostic criteria include a typical filling defect of the renal pelvis or calyces by pyelography, the demonstration of cornified squamous epithelial cells in the urine and a preceding history of infection.

If the condition is unilateral, nephrectomy is the treatment of choice. If the condition is bilateral symptomatic treatment to control infection and promote adequate renal pelvis drainage is employed.—*R. M. Harvey, M.D.*

SENGER, F. L., BELL, A. L. L., and BARNETT, J. C. Six cases of Wilms' tumor (embryonal carcinosarcoma) one of which recovered. *J. Urol.*, March, 1950, *63*, 480–486.

The authors discuss the incidence, histogenesis and pathology of Wilms' tumor. They encountered 6 cases during twenty-one years at the Long Island College Hospital. All 6 cases were subjected to nephrectomy with no operative deaths. Four cases were given preoperative irradiation to practical tolerance and practical reduction of the size of the mass. One case had neither preoperative nor postoperative irradiation and 1 case only postoperative irradiation. Both of these latter 2 cases died within seven months of operation. No cases had hypertension.

Only 1 child survived operation for more than two years and that child is alive and

apparently well after six years. This child did not receive postoperative irradiation. She was given 2,400 r to the skin over the kidney in twelve treatments prior to operation. Details of the 6 cases are given including dosage used in irradiation.

The authors have no explanation for the survival of the single case. They suggest that eventually total body irradiation combined with local tumor irradiation both pre- and postoperatively may be advantageous.—*R. M. Harvey, M.D.*

Cocchi, Umberto. Thorotrastspeicherung nach direkter Pyelographie. (Thorotrast storage following direct pyelography.) *Radiol. clin.*, March, 1950, *19*, 118–120.

The author found thorotrast deposits twelve years after a retrograde pyelographic examination had been performed. The patient was a woman fifty-eight years old who was admitted to the University Hospital of Zürich with the findings of a severe hypertension which was known to have gradually progressed for a period of ten years. The blood pressure at the time of admission was 255/150.

Simple roentgenograms showed that the thorotrast deposits were scattered throughout both renal areas and in the regional lymph vessels. Intravenous pyelography elicited an otherwise normal appearance of the urinary apparatus. Cystoscopy revealed a chronic cystitis. There was a good function of the kidneys and the sediment study was negative.

In conjunction with this observation the author refers briefly to a publication of Schaffhauser (*Helvet. Chir. Acta*, 1945, 366) who reported the pathologic findings of similarly affected kidneys in 2 cases, five and six years respectively after retrograde pyelography with thorotrast. The foreign body deposits were found partly phagocytized within the cells and partly stored in the interstitial tissue. In the cortex they were located at sites where the tubules had been destroyed. In some locations a calcification of the thorotrast masses had taken place; in others, circumscribed areas of necrosis were present with calcified thorotrast masses in the center. Similar findings were reported by other investigators.

Contrary to animal experiments, a malignant degeneration has not as yet been observed following thorotrast storage in the human.—*T. Leucutia, M.D.*

Ostry, H. Leiomyosarcoma of the prostate; with a bronchogenic carcinoma. *Brit. J. Urol.*, March, 1950, *22*, 58–62.

This unusual combination of diseases was present in a sixty-eight year old man. He complained of pain in his right shoulder in addition to rather typical prostatic obstruction symptoms. Roentgen study revealed that the vertical diameter of the sixth cervical segment was diminished and the fifth-sixth disc space was almost completely lost. The appearance was suggestive of neoplastic disease. Roentgenogram of the chest showed a hazy peribronchial infiltration extending from the right hilus of not too intense a type. Soon thereafter a swelling was noted on the medial end of the right clavicle and this gradually increased to the size of a walnut. On roentgen examination there was a destructive bone process at the medial end of the clavicle. A biopsy was taken and the microscopic report was that of an epidermoid carcinoma or at least an anaplastic type of carcinoma. The patient subsequently had hemorrhages into the bladder from his prostatic enlargement and also developed a cough and expectorated some blood. He subsequently died and autopsy revealed an epidermoid bronchogenic carcinoma of the right lung in the lower lobe main bronchus with metastases to the peribronchial, mediastinal, cervical and abdominal lymph nodes, the cervical spine and the right clavicle and liver. The prostate showed a concomitant lesion, namely a leiomyosarcoma, measuring 3 cm. in diameter at its highest part and invading the wall of the bladder at its base.

The case herein reported probably represents 1 of no more than 16 cases of this condition which have been reported. The bronchogenic carcinoma was thought to have been the cause of death.—*A. J. Present, M.D.*

Burkitt, R. T. A case of carcinoma of the prostate presenting some unusual features. *Brit. J. Urol.*, March, 1950, *22*, 56–57.

The patient in this case report presented a history of pain in the left thigh and buttock of two months' duration and evidences of urinary obstruction. He showed tenderness in the left thigh and movements of the left hip were painful. The prostate was extremely large, hard and irregular and there was a hard fixed mass in the right iliac fossa. On roentgen examination two dissimilar bone conditions were

found. There were multiple areas of destruction in the lumbar vertebrae and in the symphysis suggesting osteolytic lesions and there was an oval cystic area in the left femoral shaft.

The patient was controlled with endocrine therapy for a period of about ten months but then his symptoms recurred and he died after surgery. It was found that the lesions in the symphysis and in the lumbar spine were in truth due to osteolytic metastases whereas the cystic lesion in the femur was probably an old focus of osteomyelitis and not related to the neoplastic disease.—*A. J. Present, M.D.*

PAVLOVSKY, ALEJANDRO J., AGUIRRE, S. GONZÁLEZ, and SCHAVELZON, JOSÉ. Anastomosis esplenorrenal para el tratamiento de la hipertensión portal; a propósito de un caso. (Splenic-renal anastomosis for the treatment of portal hypertension; case report.) *Prensa méd. argent.*, Feb. 24, 1950, *37*, 359–363.

The first portocaval anastomosis was performed by Eck in dogs in 1877. Since that time occasional attempts have been made to apply the method in man for the treatment of cirrhosis of the liver, by devising various ways of shunting the portal circulation.

The author recently performed a splenectomy followed by an end-to-end anastomosis of the splenic and renal veins together with removal of the left kidney in a girl ten years of age who was afflicted with Banti's syndrome.

The case is presented in detail and the operation which was the first of its kind in Argentina is discussed at length.

The disease started rather suddenly, five months prior to operation, with attacks of vomiting and severe hematemesis which repeated themselves after each meal. Immediately a marked anemia developed necessitating daily blood transfusions. On examination, the patient exhibited all the signs of a Banti's syndrome; i.e., enormous splenomegaly, secondary anemia with leukopenia and thrombocytopenia, and above all very extensive varicosities of the esophagus which were the source of the bleeding. Three successive roentgenologic examinations of the esophagus and stomach revealed typical patterns of esophageal varices and thus were instrumental in establishing the diagnosis of obstructive portal hypertension. The authors assumed that the obstruction was due to thrombosis neonatorum which has spread from the umbilical vein to the portal system.

Prior to operation an intravenous pyelography was also done to ascertain the normal relationship of the left kidney which was to be sacrificed and the good function of the right kidney.

The patient made an excellent recovery. The hematemesis stopped immediately and when re-examined five months later, she had a normal blood count and had gained 17 kg. in weight.

It is hoped that with further improvement of the operative technique an end-to-side anastomosis may be performed, thus saving the left kidney.—*T. Leucutia, M.D.*

WALTON, J. N. Phaeochromocytoma of the adrenal. *Lancet*, March 11, 1950, *1*, 438–443.

The disease occurs equally in the two sexes and most often between the ages of twenty and forty-five although several cases have been reported in children. A familial tendency has been noted. The great majority of the tumors are benign although 15 clearly malignant tumors have been reported. The tumors produce their effect by means of a pressor substance akin to adrenaline and more recently called noradrenaline which is found in excess in the circulating blood.

The clinical picture falls into one of five categories: (1) paroxysmal hypertension, (2) persistent hypertension, (3) malignancy, (4) Addison's disease due to compression of the adrenal cortex, and (5) asymptomatic. Cases of the first category are diagnosed principally by the clinical evidence alone. It is in the second category that one of the new diagnostic tests may prove of special value.

1. Increased adrenaline in circulatory blood (not always found) (Biskind, 1947).

2. Rise in serum-potassium during paroxysms (Blacklock, 1947).

3. Histamine diphosphate and normal saline by vein produces only slight rise in pressure in the normal or hypertensive individual, but in a case of pheochromocytoma the blood pressure rose about 100 mm. Hg. within five minutes and a typical paroxysm was provoked. The disadvantage of this test is that it induces a further attack in an already ill patient (Roth and Kvale, 1945).

4. Mecholyl (25 mg. by subcutaneous injection) in one case is reported as having caused a sharp rise in blood pressure (Guarneri and Evans, 1948).

5. Piperidylmethyl benzodiozane (933F) re-

ported by Goldenberg, 1947, caused a fall of at least 50 mm. Hg. in blood pressure during a paroxysm. This test is negative in essential hypertension.

6. Dibenamine hydrochloride by vein in normal saline produced a fall of over 50 mm. Hg. in blood pressure during a paroxysm (Spear and Griswold, 1948).

The tumor may be palpable in about one-third of cases. Tomography and pyelography are of value in showing displacement or distortion of the renal pelvis or calyces. Perirenal air insufflation has been used many times, but is not without danger. Laparotomy may have to be resorted to in order to localize the tumor.

Treatment of choice is extirpation of the growth. Roentgen therapy has only a palliation effect, but it has been successful in a recurrence after operation.

Careful preparation of the patient by sedation and avoidance of excitement are important. Spinal anesthesia should be avoided, although there is little evidence that the type of anesthesia has any bearing on postoperative collapse. The blood pressure may fall precipitously on removal of the tumor. It is recommended that continuous intravenous saline be kept running from the start of the operation in order to have a convenient means of giving intravenous medication. Death may ensue from handling of the tumor, and postoperative hypotension may be a serious factor.

The author reports one case operated upon with a fatal outcome.—*R. K. Arbuckle, M.D.*

Kenyon, Herbert R. Perforations in transurethral operations; technic for immediate diagnosis and management of extravasations. *J.A.M.A.*, March 18, 1950, *142*, 798–802.

With the increase in transurethral techniques used in treating vesical and prostatic lesions, there has been an increase in the incidence of operative accidents. Those most commonly encountered are perforations of the bladder wall, prostatic capsule, or the urethra.

The author has instituted a routine for the early diagnosis of accidental perforations. Low spinal anesthesia is employed for his transurethral surgery. If there are indications that perforation has occurred, the operation is discontinued and cystography or urethrocystography is performed immediately. Roentgenograms are made both with the bladder filled and after emptying. Extravasation of the contrast medium indicates the location and extent of the perforation and proper management is instituted immediately.

Several case histories and roentgenograms are presented illustrating the various types of perforations. Methods and results of treatment are discussed.—*W. C. MacCarty, Jr., M.D.*

Petkovic, Sava. Tumors in vesical diverticula. *Urol. & Cutan. Rev.*, March, 1950, *54*, 152–155.

These tumors are more prominent in the male than in the female and the average age of the patients is from fifty to seventy years. The symptomatology is similar to that of tumor of the bladder except that the hematuria may be preceded by signs and symptoms of chronic vesical neck obstruction and bladder infection.

The diagnosis may be made by cystoscopic examination in about one-third of the cases. Intravenous pyelography and cystography are of considerable value in the evaluation of these cases. The survey film may show evidence of a calculus and the dye-filled bladder may demonstrate a diverticulum with or without opaque or nonopaque filling defects. In the smaller tumors in a diverticulum the filling defect may be overlooked but a defect due to a blood clot or stone may be present. The exact preoperative diagnosis may be difficult by cystoscopy or roentgenography, and in almost two-thirds of the cases presented the diagnosis was not made until operation or autopsy.

The treatment of carcinoma or diverticulum of the bladder should be by radical surgery whenever possible. In exceptional cases, radiation therapy may be of some value. In general, the prognosis is unsatisfactory, cases of cure being limited to rather rare single case reports in the literature.—*G. W. Chamberlin, M.D.*

Waller, John I., and Adney, Frank. Vesical calculi in young female children. *Am. J. Dis. Child.*, April, 1950, *79*, 684–691.

A case is reported of a vesical calculus in a young female child of five years of age. The rarity of the condition in female children is emphasized. The calculus was secondary to a foreign body in the urinary bladder, a roentgenogram having shown a large calculus surrounding a bobby pin. An intravenous pyelogram revealed a prominent hydronephrosis of the left kidney with hydroureter. The right kidney was

normal. A cystogram showed no evidence of perforation of the bladder by the foreign body.

The hydronephrosis resulted from obstruction of the left ureter by the stone. It was greatly improved in two weeks after removal of the calculus. Suprapubic cystotomy is recommended as the treatment of choice for large vesical calculi in young female children. Prior to the authors' case there were no cases of vesical calculus in female children in a series of 118 patients with vesical calculus operated upon by various surgeons at the Indianapolis General Hospital from 1934 to 1948.—*R. S. Bromer, M.D.*

KIMBROUGH, JAMES C., DENSLOW, JOSEPH C., and WORGAN, DAVID K. Urinary tract calculi in recumbent patients. *J.A.M.A.*, March 18, 1950, *142*, 787–789.

Eight hundred and sixty-four patients with bone injury were kept at bed rest for three months or more. An attempt was made to find the patients in this group who might be susceptible to calculus formation.

Patients who had a positive history of urinary tract disease with changes in the urinary tract and/or calcium metabolism, that is, a daily urinary excretion of calcium above 225 mg. per 100 cc., were placed on a rigid regimen. This included: (1) a minimum of 4,000 cc. daily fluid intake; (2) avoiding stasis and promoting ambulation; (3) removing infection focally or in the urinary tract; (4) dietary measures consisting of an acid ash diet, high Vitamin A and B and limited calcium intake, and (5), medicines to increase urinary acidity and to decrease phosphorus excretion such as aluminum hydroxide gel, estrogens, sodium biphosphate or mandelic acid.

In the majority of patients with a normal history and normal findings in the urinary tract, calculus formation can be prevented by maintaining adequate fluid intake and early, if only partial ambulation.

In the total group, 2 patients were observed with urinary calculi; in one, the calculi had formed prior to admission, and in the other, adequate stone preventing care could not be properly maintained.

The authors found that by examining and grouping the patients, only a few special ones will require the rigid calculus-preventing regimen. This grouping and selecting of patients will save enormous efforts in the care of the recumbent patient with bone injury.—*F. J. Rigos, M.D.*

NERVOUS SYSTEM

ERNST, EDWIN C., JR., and HEILBRUN, NORMAN. The diagnosis of intraspinal hemangiomas by myelography. *Radiology*, March, 1950, *54*, 417–420.

Three cases are reported in which an intramedullary vascular lesion of the spinal cord was demonstrated with pantopaque and verified by surgery. Defects were mainly pulsating tortuous linear striations of decreased density. The plain roentgen studies revealed no abnormalities.—*E. E. Seedorf, M.D.*

WILLIAMS, DENIS. Boeck's sarcoidosis of the nervous system. *Proc. Roy. Soc. Med.*, April 1950, *43*, 253–254.

The case history of a thirty-nine year old male with clinical and roentgenological findings of sarcoidosis is presented.

The patient was in excellent health until May, 1948, when the initial symptoms of his present illness began. Involvement of the central nervous system was revealed by progressive sensory, motor and speech disturbances. Clinically the lesions were localized to both cerebral hemispheres, the left cerebellar mechanism, and probably the right optic nerve.

A film of the chest in October, 1949, showed irregular coarse mottling in both lung fields and prominent hilar shadows. Ventriculography was negative. Roentgenograms of the hands showed small cyst-like areas in the heads of both first metacarpals.—*D. R. Bernhardt, M.D.*

BASSETT, ROBERT C. The neurologic deficit associated with lipomas of the cauda equina. *Ann. Surg.*, Jan., 1950, *131*, 109–116.

The early recognition and treatment of lipomas of the cauda equina is important so that irreversible neurological changes can be prevented. This type of congenital involvement of the spinal cord is apparently less well understood than others.

Lipomas result from overabundance of fatty tissue and protrusion into the dural space or from inclusion within the dura at the time of closure of the neural tube. As the skeletal development of the spine progresses, the conus medullaris comes to lie at progressively higher levels. In these cases, however, the conus is fixed by the lipoma, and more and more traction

is applied to the conus and cauda equina as growth progresses. Additional accumulation of fat also accentuates the symptoms by direct pressure.

The diagnosis is not difficult since the lipomatous mass is seen in or near the midline and is associated with a bifid deformity of the neural arches of the lumbosacral spine. Disturbances of bowel and bladder function, progressive peripheral neuropathy, pelvic skeletal, and trophic changes are also seen.

The treatment is surgical excision, preferably during the first three or four months of life before the mechanical traction can cause irreversible changes. The patients are warned against excessive weight gain.

Details of the surgical technique are given; the lipoma is dissected free, the stalk attaching it to the conus is divided and the wound closed. Nine case reports are presented.—*K. L. Krabbenhoft, M.D.*

Buchan, J. F. Intraspinal neurofibroma and ? neurofibroma of neck. *Proc. Roy. Soc. Med.*, April, 1950, *43*, 315.

The case history of a forty-three year old male with the chief complaint of pain in the right hip, thigh and knee is presented. The pain had a sudden onset following defecation twelve years previously. Eighteen months ago the pain became more severe and the patient lost about 22 lb. Intramuscular injections of benzyl salicylate and later application of a plaster jacket gave no relief.

Physical examination showed the patient's general condition to be good. A hard lump was felt deep to the left sternocleidomastoid muscle. Lumbodorsal spinal movements were limited with slight kyphoscoliosis. The right thigh was wasted with absence of the right knee-jerk. Ankle-jerks were present and equal bilaterally. Lumbar puncture revealed Froin's syndrome.

Roentgenograms of the spine revealed an increase in the space between the pedicles of T12 and L1. There was erosion of the pedicles on the left side and on the posterior aspects of the bodies of these vertebrae. The left T12–L1 vertebral foramen was much enlarged.

At operation a large neurofibroma was found arising probably from the 1st and 2nd lumbar nerves and extending out through the intervertebral foramen. The nerve roots of the conus medullaris and the cauda equina were flattened and pushed to the left by the tumor. There was good operative result.—*D. R. Bernhardt, M.D.*

Sames, C. Patrick. Dumb-bell ganglioneuromata. *Brit. J. Surg.*, April, 1950, *37*, 467–471.

The author reports a case of ganglioneuroma occurring in a three year old girl. An extensive paraplegia was present due to pressure from the intraspinous extrathecal component of the tumor. The tumor was removed in two stages and the case was followed for five years.

Ganglioneuromas with dumb-bell characteristics are rare, as only 7 cases have been previously reported. A brief summary of these cases is given.

The author stresses the following features of this type of tumor: (1) it occurs in early childhood, especially between the ages of two and five years, (2) it is located in the upper thoracic region, (3) its paravertebral or extraspinous component appears as a posterior mediastinal mass on roentgenography, (4) signs of spinal compression occur when the tumor is extradural and situated anterior to the cord, (5) histopathologically no medullated nerve fibers are seen, (6) kyphoscoliosis is often present.

The possibility that these tumors are at first malignant, and later, with the growth of the host, become more differentiated, or benign, is discussed. They arise from the sympathetic system, probably neo-or pre-natally before or during the migration of the sympathetic system laterally from the neural crest, and the dumb-bell shape results from the formation of the vertebral column around the tumor, rather than prolongation of the tumor into the intervertebral foramina. Owing to their occurrence at a very early age, when the developing sympathetic cells are primitive in type, such tumors are in the beginning "neuroblastomatous" in nature. Later they may, and in fact usually do, become more differentiated, changing into benign ganglioneuromas.

In the reported case calcification occurred within the tumor; this apparently was not observed previously in any case of dumb-bell ganglioneuroma.—*G. J. Culver, M.D.*

SKELETAL SYSTEM

Henny, George C. Roentgenographic estimation of the mineral content of bone. *Radiology*, Feb., 1950, *54*, 202–210.

The mineral content of bone varies in health to a slight degree but there may be marked change in disease. It is of interest to estimate

the mineral content in certain diseases such as hyperparathyroidism. The author describes his method of estimating the mineral content of the adult femur. This procedure depends on a comparison of roentgen-ray absorption in a section of the femur as compared to the absorption in a ladder made of thin slices of dried beef bone. Quantitative analysis of the beef bone for calcium and phosphorus enables one to compare bone densities on the roentgenogram and then express the mineral content of the femur in milligrams per cubic millimeter.—*C. A. Stevenson, M.D.*

FRIED, CHARLES T., and GRAND, MILTON J. H. Hypervitaminosis A. *Am. J. Dis. Child.*, March, 1950, *79*, 475–486.

Hypervitaminosis A is a clinical entity which occurs in late infancy and early childhood. The pathologic processes are the result of a prolonged and excessive intake of vitamin A and a derangement of vitamin A metabolism. Clinically, the condition is manifested by anorexia, with loss of weight, extreme irritability, fretfulness, low grade fever, pruriginous rash, sparseness of hair, hepatomegaly and exquisite pain on pressure over the long bones. Biochemically there are abnormally high vitamin A levels in the blood serum and increased levels of the serum lipids.

Two cases are reported in this paper. Both patients were given excessive doses of vitamin A. They had the highest blood serum levels of vitamin A ever reported. The authors suggest hepatic dysfunction as the basis for the pathogenesis of this syndrome rather than supersaturation of the liver with vitamin A. Curves for vitamin A absorption are shown as evidence of hepatic dysfunction.

The roentgenograms of the first patient showed periosteal thickening involving the shafts of the right and left ulnas at the midportions, gradually tapering off toward the ends of the bones. There was lateral bowing of the shafts of the lower extremities, with widening of the ends of the bones and slight sclerosis. Three weeks later another roentgenographic examination showed evidence of healing by the appearance of smoother epiphyseal surfaces which on the first examination had been irregular in outline.

In the second case, roentgenographic examination showed periosteal thickening involving the middle third of the shafts of both tibias, the left ulna and the lower part of the right ulna. The lower jaw, clavicles and scapulas showed no abnormalities.—*R. S. Bromer, M.D.*

FREEMAN, SMITH, and DUNSKY, IRVIN. Resistant rickets. *Am. J. Dis. Child.*, March, 1950, *79*, 409–427.

In this paper the authors enumerate the principal effects of vitamin D, the literature on resistant rickets is reviewed and a case of resistant rickets is reported. They interpret the findings on the patient in the light of current knowledge concerning the action of vitamin D. In their patient large doses of vitamin D produced the following effects: (1) increased calcium and phosphorus absorption from the intestine; (2) increased reabsorption of phosphate from the glomerular filtrate; (3) reduced rate of disappearance of intravenously injected phosphate, and (4) healing of the rickets. A low fasting serum inorganic phosphorus level persisted throughout the period of their study. They concluded that the large doses of vitamin D did not correct or entirely compensate for the inherent metabolic defect existing in the child.

In their comment and discussion they istl the diseases to be differentiated from resistant rickets, eccentro-osteochondrodysplasia (Morquio's disease), osteochondrodystrophy, renal rickets, osteitis fibrosa cystica (Albright's disease) and renal tubular rickets (Fanconi). The danger of osteotomy and more specifically of skeletal immobilization, in patients with refractory rickets, is mentioned. This is true especially in those patients to whom large doses of vitamin D is being given. High levels of serum calcium and an abnormally high level of urinary excretion of calcium may ensue with serious impairment of renal function.

The roentgenogram of the lower extremities of their patient showed the characteristic deformity of resistant rickets. Serial roentgenograms of a wrist taken before and during treatment showed essentially healing rickets but with a later recurrence and again some evidence of healing.—*R. S. Bromer, M.D.*

ELVIDGE, ARTHUR R, and LI, CHOH-LUH. Central protrusion of cervical intervertebral disk involving descending trigeminal tract; report of a case. *Arch. Neurol. & Psychiat.*, March, 1950, *63*, 455–466.

This paper once more points out the fact that central protrusion of a cervical vertebral

disk may give rise to symptoms simulating tumor of the cord, syringomyelia, angina pectoris or even multiple sclerosis or amyotrophic lateral sclerosis. The authors also report involvement of the spinal tract of the trigeminal nerve in association with protrusion of a cervical intervertebral disk which to their knowledge has never before been reported. The caudal limit of the descending tract, its central representation and the presence of tactile conducting fibers are discussed.

The mechanism for the development of precordial pain in cases of protruded cervical intervertebral disk is still not clear. If the pain provoked from the disk itself is segmentally distributed, a bilateral distribution is more likely to occur. Other authors, however, were able to reproduce the patient's precordial pain by applying pressure to the protruded disk itself.

Bony proliferation is rather common in cases of protruded intervertebral disk. Roentgenograms in the case reported revealed pronounced osteoarthritis of the fifth, sixth and seventh cervical vertebrae with loss of disk spacing at these levels. Myelographic examination showed a filling defect from the lower border of the third to that of the fifth cervical vertebra. The defect was thought to be due to arachnoid adhesions rather than tumor. At operation many fine adhesions between the dura and the arachnoid were found and there were also subarachnoid loculations which may have been responsible in part for the bizarre clinical features. However, the consistency of the extruded cartilaginous mass on palpation is comparable to that of bone and the irritation created by its constant rubbing on the cord or on the nerve root is undoubtedly greater than that resulting from a soft neoplasm. Being fixed to the spine, furthermore, its frictional effect on the constantly moving cord or nerve root has a wider range then does that of a tumor arising from the dura or from the cord itself. A vascular mechanism from compression of the anterior spinal artery may be set in motion, giving rise to spasm, closure or thrombosis.

Horner's syndrome has occasionally been observed; this apparently is due to interruption of the sympathetic outflow to the limb, as well as to paralysis of the ciliospinal pathway.—*K. K. Latteier, M.D.*

Hart, F. Dudley. The respiratory factor in ankylosing spondylitis. *Proc. Roy. Soc. Med.*, March, 1950, *43*, 213–216.

In a recent inquiry at Westminster Hospital it was found that of 62 patients with ankylosing spondylitis 46 had experienced tightness and discomfort in the chest wall on deep inspiration at some time after the onset of the disease.

Ankylosing spondylitis starts insidiously usually in the lower spine, and the sacroiliac, joints are early affected. However, by the time the patient comes to a hospital or for medical attention there is often limitation of thoracic expansion.

Every thoracic vertebra has eight articular facets. All these may be affected though commonly the involvement is a patchy and irregular one. The result is pain and limitation of costal movement in early stages and complete fixation with bony fusion in the late stages of advanced cases. Respiration is largely diaphragmatic. Patients complain of stiffness and immobility of the chest wall and inability to take a deep breath, also occasionally tenderness in sternum and/or ribs. Inflammatory changes in the spine may be referred to points lower in the chest or to the flanks or abdomen, simulating girdle pains of other diseases. Exertional dyspnea may be caused and varying deformities of the dorsal spine are noted.

Roentgen examination is utilized with double exposure on inspiration and expiration to show mobility or immobility of ribs and diaphragms, and to demonstrate changes in the various articulations and bone components of the regional spine.

In severe cases with thoracic discomfort predominating deep roentgen therapy appears to give greater relief than any other measure.

Symptoms resulting from restricted respiratory movement of the thoracic wall by spondylitis are distinguishable from the dyspnea of cardiac or pulmonary disease by the differentiating features as follows:

(a) Spinal rigidity with absence or diminution of spinal extension.

(b) Diminished chest expansion with no physical signs in lungs.

(c) Chest is fixed in partial expiration, i.e., the position of rest, rather than partial inspiration as in emphysema or bronchitis.

(d) Absence of bronchial spasm and cough.

(e) Occasional tenderness on percussion over the sternum, and less commonly the adjacent costal cartilages and the lower ribs.

The article is illustrated with reproductions of roentgenograms of double exposures and bone components of the upper dorsal spine. There is one photograph of relationship of bone components of spine and a table showing vital capacity with degrees of flexion and cervical dorsal motion in 7 patients.—*J. H. Gilmore, M.D.*

POWELL, F. I. Fracture of the first rib; its occurrence and clinical diagnosis. *Brit. M. J.*, Feb. 4, 1950, *1*, 282–285.

Twenty-five cases of fracture of the first rib (13 on the right, 11 on the left, and 1 bilateral) are discussed. The probable mechanism of this fracture is not settled and the different explanations are presented. In the acute form there is pain on active abduction of the arm and pain on deep inspiration with compression of the ribs. The pain is felt under the shoulder blade and there is some weakness in the grip on the affected side. Most of the patients were between eighteen and nineteen years of age with 5 over nineteen. Many of the cases followed the lifting of heavy objects, many had no history of trauma or pain. The site of the fracture was remarkably constant in the region of the scalene tubercle. There does not seem to be any correlation between the roentgen picture and the presence or absence of symptoms. The article gives the general impression that all cases recover without residual pain, but this is not definitely stated. Two cases with pseudarthrosis were asymptomatic.—*J. M. Dell, Jr., M.D.*

MESCHAN, I., SCRUGGS, J. B., JR., and CALHOUN, J. D. Convulsive fractures of the dorsal spine following electric-shock therapy. *Radiology*, Feb., 1950, *54*, 180–193.

This paper is a detailed study of vetebral fractures occurring in 35 per cent of 212 patients who received electric shock therapy for mental disease. Similar detailed studies have been reported following the use of metrazol and the incidence of vertebral fracture reported here is about the same as reported from the use of metrazol. In these cases studied following electric shock therapy the most common site of fracture was in the upper dorsal spine and the highest incidence of occurrence was during the first three treatments. Anterior narrowing of the vertebral bodies prior to treatment seemed to predispose to fracture but not necessarily of the narrowed vertebrae themselves. Curare materially helped to reduce the incidence of fractures.—*C. A. Stevenson, M.D.*

WYCIS, HENRY. Contralateral recurrent herniated disks. *Arch. Surg.*, Feb., 1950, *60*, 274–278.

A report is given of 4 cases of contralateral herniation of an intervertebral disc following operative removal of the opposite side of the disc. Recurrence was at the same level and developed in a few weeks to three and one-half years. Three cases were verified at operation. These 4 cases represent a 1.3 per cent recurrence rate in the author's series of 300 cases. The report of these cases may influence a more complete laminectomy with bilateral exploration. One case with left sciatic pain was relieved by operative removal of a partially protruded disc on the right side. The myelogram in this case was reported as showing a posterior protrusion without notation as to whether the defect was right or left, presumably a midline protrusion.—*J. M. Dell, Jr., M.D.*

VALLS, JOSÉ, POLAK, MOISES, and SCHAJOWICZ, FRITZ. Fibrous dysplasia of bone. *J. Bone & Joint Surg.*, April, 1950, *32A*, 311–322.

The material studied in this paper consisted of cases of fibrous dysplasia of the monostotic form with one lesion and the same form with several foci which at times were confluent; the polyostotic form, limited to a few bones (diostotic and monomelic), and the polyostotic form involving many bones in some cases without extra-osseous manifestations and in others with cutaneous pigmentation and precocious puberty (Albright's syndrome). In addition, 1 case of neurinoma with osseous lesions, but without craniohypophyseal lesions was included in the study. The 10 cases mentioned were classified by the authors as histiocytic granuloma.

In addition to the usual staining techniques with both paraffin and celloidin sections, the authors employed all the variations of Rio Hortega, especially those designed for mesenchymal and nerve elements, and those of Bielschowsky and Ramón and Cajal for frozen sections. By utilizing the stains for lipoid substances, they attempted to clarify the existing relationship between xanthomatosis and fibrous dysplasia of bone.

Their investigations do not permit them to

affirm emphatically, as have Lichtenstein and Jaffe and other authors, that the term "fibrous dysplasia" can be applied with certainty to the solitary form and especially to such a group of processes as osseous xanthoma (xanthomatous histiocytic granuloma), ossifying fibroma and leontiasis of bone which the authors believe have their own specific individuality. On the other hand, they believe that the term "polyostotic fibrous dysplasia" is a more adequate name than those previously employed, because they have proved in this group the presence of large cartilaginous masses in plain mesenchymal tissue. These factors, together with other clinical and roentgenographic features, would seem to confirm the relationship with a process in which the dysplastic congenital origin is unquestionable,—chondrodysplasia or Ollier's disease. On the basis of their studies, performed with special silver-impregnation techniques, the authors believe that there is no relationship between fibrous dysplasia and the neurofibromatosis of von Recklinghausen.

The authors acknowledge that the problem is a difficult one but from their study it would seem that the polyostotic form may be accepted as a real dysplasia, while the monostotic form in many instances corresponds to the final cicatricial stages of processes, rather than to dysplastic stages. In those cases where a thorough search of the clinical and the histopathological material fails to reveal some other etiology, they concur with the classification of Jaffe and Lichtenstein.

The paper contains many histological reproductions.—*R. S. Bromer, M.D.*

Russell, Lyle W., and Chandler, Fremont A. Fibrous dysplasia of bone. *J. Bone & Joint Surg.*, April, 1950, *32-A*, 323–337.

The term "fibrous dysplasia" has been employed in recent years to designate certain types of osseous changes that may either be limited to a solitary focus (monostotic fibrous dysplasia) or distributed in multiple areas (polyostotic fibrous dysplasia). The etiology and pathogenesis of both forms have remained obscure, and opinions have differed as to the possible relationship of one disease process to the other and to the condition known as Albright's syndrome. The authors state their purpose in making this report is to compare the clinical, roentgenographic and pathological findings, and to note the effects of treatment in the three types of disease. During the past three years they have studied 7 patients, each having a solitary osseous lesion, 3 patients with two or more defects, and 1 patient showing widespread changes, precocious puberty and areas of dermal pigmentation.

From their study of these cases, the authors found that the basic morphology of all three groups includes replacement of cortical and cancellous bone and marrow by fibrous connective tissue, containing varying amounts of imperfect cancellous bone. The etiology and pathogenesis of fibrous dysplasia of bone are still obscure. The diagnosis may sometimes be made on the basis of clinical and roentgenographic examinations but often a biopsy is necessary to differentiate from other conditions.

The roentgenograms of the osseous lesions showed either a "cystic" or a "ground-glass" appearance. Lesions resembling bone cysts showed areas of radiolucency of varying sizes. There were no areas of increased density surrounding radiolucent areas. In some of the cystic lesions the bone was expanded and the cortex was thinned. None of their lesions had a multiocular appearance. The ground-glass appearance was characterized by areas of homogeneous or granular density, obliterating the medullary space.

The differential diagnosis must be made from hyperparathyroidism, simple bone cyst, giant cell tumor and osteogenesis imperfecta, of the type which does not become manifest until childhood, adolescence or adult life, with occurrence of pain or pathological fracture.

The only known treatment which is effective is surgery and it may be indicated when one of three conditions exists: (1) continued pain in the region of a localized bone lesion, (2) fracture through a lesion, or (3) severe bowing as a result of spontaneous fracture. The authors recommend reduction and immobilization of pathological fractures, correction of deformities and surgical excision of painful lesions, whenever possible.—*R. S. Bromer, M.D.*

Zadek, Isadore. Acute non-tuberculous psoas abscess: a clinical entity; report of seven cases. *J. Bone & Joint Surg.*, April, 1950, *32-A*, 433–438.

Of 7 cases of acute psoas abscess of non-tuberculous origin reported in this paper, none was the result of direct extension from a pelvic organ, such as an acutely inflamed appendix.

None followed a postpartum infection. None was an extension upward, such as cellulitis or lymphangitis, from an affected lower extremity, or an extension downward, as from empyema. One patient, aged twenty-four, had had osteomyelitis on her left tibia in childhood and local heat was still evident over the affected bone, probably the source of her infection. Another had had acute cellulitis about the left knee, which had been drained twice just prior to the development of the psoas abscess. The abscess was not spreading and was under control. The other cases were cryptogenic.

The author states that it seems hardly necessary to point out the signs of psoas abscess. What is necessary is to be aware of the existence of the acute psoas abscess as a clinical entity, and to suspect it in a patient who is acutely or moderately ill, who has fever and pain in a pelvic fossa or in the loin with pain referred to the hip, groin, thigh or lower back, and whose clinical picture does not indicate a characteristic perinephritic or intra-abdominal lesion.

Of the 7 cases, in only 1 was there roentgen evidence of the condition as shown by bulging of the iliopsoas on the affected side.

The infecting organism was *Staphylococcus aureus* in 5 abscesses. In 1 it was *Streptococcus haemolyticus*. No growth was obtained from the pus of 1 abscess. This patient had been receiving penicillin for several days prior to the examination. In this case the Wassermann reaction was positive.—*R. S. Bromer, M.D.*

HUTTER, CHARLES G. Unicameral bone cyst; report of an unusual case. *J. Bone & Joint Surg.*, April, 1950, *32-A*, 430–432.

The roentgenographic criteria of a unicameral bone cyst as summarized by Jaffe and Lichtenstein is the location near or relatively near to an epiphyseal cartilage plate and the fact that it rarely, if ever, transgresses the plate to both in the shaft and in the neighboring epiphysis. According to them, a cyst developing in a long bone after fusion of the epiphysis with the shaft may be found to involve both part of the shaft and the adjacent epiphyseal end of the bone.

Hutter reports the case of a unicameral bone cyst in the tibia of a girl, six and one-half years old. The roentgenogram showed an area of rarefaction in the medial portion of the right tibia, at the knee joint. This was a single discrete area, sharply demarcated from the adjacent normal-appearing tibia, and apparently contiguous with a similar area of rarefaction at the medial edge of the epiphysis. One portion of the cortex appeared to have been eroded by the underlying process. A skeletal survey of the remaining bones failed to show other bone defects.

At microscopic examination the specimen consisted of small fragments of fibrous tissue. There was evidence of osteoid formation in some areas. Upon one edge there was alignment of cells, suggesting the formation of a lining membrane. There were some areas of increased vascularity and some evidence of recent hemorrhage. The findings were consistent with those of a unicameral bone cyst.

Hutter concludes that apparently the cysts are usually delimited by the cartilage plate from extension into the epiphysis, but this rule is not infallible and one must not be guided by this finding alone in arriving at a preoperative diagnosis. A defect in the cartilage plate may not limit the growth in the area unless the peripheral portion of the plate, that adjacent to the cortex, is also destroyed. Curettage and filling the cavity with bone chips arrests the progress of the lesion and results in the cavity being filled with normal appearing bone. Even when a cavity is packed, so that the bone crosses into the epiphyseal area through a defect in the epiphyseal-cartilage plate, it probably will not arrest normal bone growth.—*R. S. Bromer, M.D.*